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As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

CONTENTS

	Page
Editorial Comment	301
Testing PA Equipment	302
Return from Malaya	306
Unbiased	308
Television Relay Systems	309
Broadcast Programmes	310
Timing London's Buses	311
Practical Aspects of Design	312
Ambassador Superheterodyne Reviewed	314
News of the Week	316
Television Topics	318
Random Radiations	320
Principal Broadcasting Stations	322
Recent Inventions	324

EDITORIAL COMMENT

Television in the Home

Relay Reception Impracticable ?

WHEN the television service was started the fact that high ground had to be chosen for the transmitter, and that at that time it was necessary for the cameras to be located very near the transmitting apparatus itself, meant that the B.B.C. had no alternative but to accommodate the television transmitter and studios on the same site and at a spot remote from other B.B.C. centres.

As improvements have been made and it has been found possible to televise from a considerable distance by means of special television cables or a short-wave wireless link, the position is gradually developing where it is no longer so essential for television to be regarded as a separate unit.

Merging Television and Sound Broadcasting

We think there is no doubt that the technical directors of the B.B.C. will be anxious to merge sound and television broadcasting more and more as time goes on. Television must ultimately become the means of illustrating the sound-broadcasting programme.

If we accept this view, a first step has been made towards planning the future of television on a satisfactory basis and, as far as wireless transmission is concerned, we anticipate that progress in this direction will be rapid.

The Relay Position

Let us now turn to a consideration of relay possibilities in relation to sound and television. Experience has shown that sound-broadcasting can be relayed by wire fairly satisfactorily, and it is for this very reason that so much concern has been felt by listeners and by the radio industry over the attitude of the Post Office in proposing to establish a nation-wide relay system which would gradually mean the disappearance of manufactured wireless sets, except in comparatively small numbers and, therefore, at vastly enhanced prices to the public.

At the same time that the proposals for a sound-broadcasting relay organisation on a national scale are being pushed, statements have been made that the ultimate distribution of television may also be by wire to individual homes.

Technical Considerations

An article in this issue discusses the possibilities of distributing television by means of a relay system, and a study of facts there revealed leads us to the conclusion that the chances of a television service by wire to individual homes are extremely remote. If this is so, and the article leaves very little doubt on the matter, then to encourage a sound-relay system will not contribute in the least to popularising television, as television receivers will still have to be designed for reception by wireless, and once we are faced with this necessity, the addition of the small amount of further apparatus for sound reception as well will add very little to the cost. If, then, for television we must continue to depend on wireless transmission, and if we agree that television and sound-broadcasting must ultimately merge as one service, it is only logical to enquire what benefit it can be to listeners to pay for a relay service for sound when a wireless receiver for television remains a necessity ?

Testing PA Equipment

Checking Amplifier Performance

By P. H. WALKER, B.Sc. (Eng.)

THE best can be got out of an amplifier only by designing it specially to fulfil a particular purpose, and it is interesting, if not always necessary, to know its technical performance in some detail. In this article it is proposed (a) to mention briefly the details of design of one of the PA amplifiers used at University College, London; (b) to describe at least one method of determining the most useful characteristics, and lastly (c) to give actual results of tests made upon the University College equipment.

PA apparatus installed at University College was designed to give really high-quality reproduction, and was built by Sound Sales, Ltd., to our specification. This specification was briefly as follows:—Two 12-watt amplifiers to a design based on *The Wireless World* Quality Amplifier, microphone amplifier with independent treble and bass tone controls, local-station receiver, volume controls on, and mixing of, all inputs, headphone monitoring jacks, output meter, output valve anode-current meter, twin turntables with record groove cue scales on the pick-up arms.

The use of two small amplifiers made the equipment much more flexible, and complete breakdown almost impossible when compared with a single 24-watt amplifier. They were arranged so that two completely independent "programmes" could be dealt with at the same time, such as stage - effects noises, independently of our stage-greenroom microphone system.[1] When required, a switch parallels the amplifiers to give a combined output of over 20 watts undistorted, though each amplifier is capable of coping with most situations when operating alone.

Provision was made for headphone monitoring with the assistance of an output meter: speech needs much more careful monitoring than music, and the relatively low fundamental frequency of speech made it possible to use an inexpensive moving-iron milliammeter as the output meter (with series resistance) or anode current meter as required. A ten-volt accumulator is used for microphone polarisation, mounted inside the cabinet in a lead box. The superiority of this method over dry batteries is very marked, particularly in regard to cost.

The radio set is a simple affair, consisting of an RF pentode feeding a power grid-detector and thence to the tone control amplifier. The tone control circuit is similar to that designed for *The Wireless World* 12-watt PA Amplifier, except that bass attenuation is provided in addition to the other ranges. It is not often required, but it becomes particularly useful for improving the intelligibility of speech at very high volume and also safeguards the loud speakers from damage.

Marconi - Reisz carbon microphones are used, while at the other end of the chain we have a number of baffle speakers, also Rola G12 PM speakers which can be bolted rapidly either on to baffles or horns, and for our more important work we are equipped with a Voigt twin diaphragm double-power unit working into a 4-foot straight horn, that has given very satisfactory results.

Turning now to the methods of measuring the performance of the equipment, we shall deal first with the frequency-response from the pick-up terminals of the tone control stage to the secondary terminals of the output transformer. The input impedance is a volume control or grid leak of 0.5 MΩ, say, and the connections between the oscillator and amplifier are arranged as in Fig. 1. Next, the output impedance into which the amplifier is designed to work must be known and a load resistance made up of this value and connected to the output transformer secondary in place of the speech coil.

There are two ways of measuring the input to the amplifier — with a valve voltmeter or with a thermo-milliammeter. The first method is always preferable if it can be made to read low voltages accurately and the instrument should be connected as shown by VV in Fig. 1. If, however, the load resistance R is made up as a fixed potential divider, the voltmeter may be connected as shown dotted and the voltage injected into the amplifier will be a known fraction of the VV reading.

Measuring the output is much simpler, and valve or metal-rectifier voltmeters may be used.

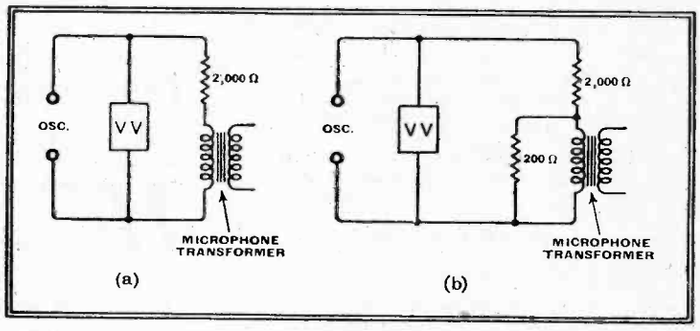


Fig. 3.—When the input is applied to the microphone transformer primary the arrangement of (a) should not be used. For correct results it is necessary to load the transformer properly as in (b).

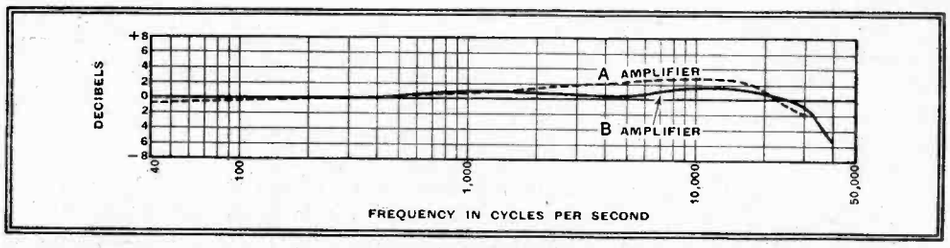


Fig. 2.—The overall response curves of two amplifiers are given here; the differences are quite small.

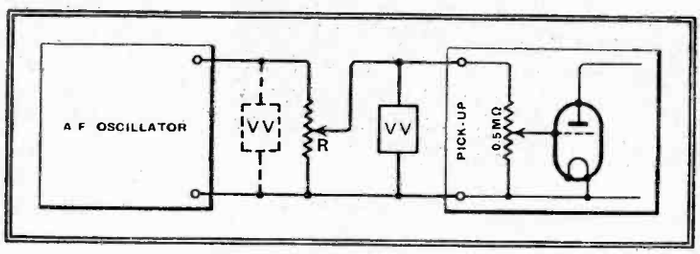


Fig. 1.—The connections between the AF oscillator and the input of the amplifier are shown here.

Output Level for Measurements

Standard practice with receiver measurements asks us to show the frequency response as the decibel ratio of the input voltage at all audio frequencies to the input voltage at 400 c/s to give a constant output of 50 milliwatts.

To the PA man, however, an output

[1] Described by the Prompter in the London *Evening News* of 16th December, 1936, and elsewhere.

Testing PA Equipment—

of 50 milliwatts is very uninteresting, and in any case in practice it is extremely difficult to adjust the oscillator voltage to give exactly that output at every frequency, not to mention the difficulty of measuring 50 milliwatts across a 7.5-ohm load. Decide on some fairly useful output, say a quarter to half the maximum undistorted power, and keep as near to this as possible at all frequencies by varying the input voltage. Changing the range of an instrument during a frequency run is responsible for many peculiar curves, so choose the output so that a preliminary frequency run shows you to be within the range of input and output meters whenever possible.

It is often more convenient to keep the input voltage constant and to measure the various voltages developed across the output load, and this method is just as accurate and has the advantage that it is not necessary to have the input voltmeter calibrated.

Whichever method is adopted, it is very important to see that overloading does not occur at any frequency. This may easily occur with an amplifier including a tone-control system.

Actually, when the characteristic is such that the gain falls off at either end of the range of audible frequencies the constant input system is less likely to lead to overloading than the constant output. The converse is true, however, when the gain rises at the ends of the frequency spectrum. This assumes, of course, that the input is chosen for a reference frequency at the middle of the band, as is usually the case.

Carrying out this test on the University College amplifiers shows the result given in Fig. 2, where it will be noted that B amplifier (solid curve) is flat within ± 1.5 db. between 40 c/s and 30,000 c/s, including the output transformer.

The next test is that of the microphone amplifier plus main amplifier, including input and output transformers. The output circuit will remain as before, but precautions must be taken with the input circuit.

If the microphone transformer is designed for an input impedance of 200Ω; the circuit shown in Fig. 3 (a) would give false readings as the transformer is not correctly loaded, but Fig. 3 (b) shows a circuit that can be relied upon to give accurate results. If V is the voltage read by the valve voltmeter, then the voltage injected into the microphone transformer will be: $\frac{200}{2,000 + 200} \times V$ volts.

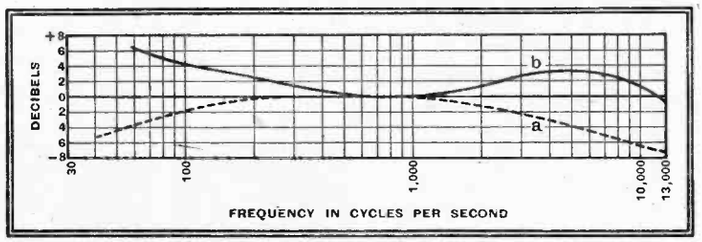


Fig. 4.—Curve (a) shows the response of the amplifier and microphone transformer, and (b) one effect of using the tone controls.

This test carried out on the U.C. amplifier gave the curve "a" shown in Fig. 4, with the tone controls in the normal position, but the curve "b" shows that the drooping nature of "a" can be corrected if necessary by an adjustment of the tone controls

The third test that we can make in regard to frequency response is to play a standard frequency record on the gramophone turntables to determine the effect the pick-up has on the curve previously obtained.

These records can be obtained with a pure sine wave tone from 50 c/s up to 8,000 c/s with both steady and gliding note. The output response curve is plotted on the assumption of constant input against a reference frequency of 1,000 c/s.

As standard frequency records are guaranteed accurate for 20 playings only, it is advisable to take exceptional care in the preliminary preparations, to avoid "dud" runs.

Fig. 5 shows the effect a Marconiphone type 7A pick-up has on B amplifier's response (Fig. 2). Though poor in comparison, the solid curve gives the response as being within ± 4.5 db. between 50 c/s and 5,500 c/s, a fair result for a moving-iron pick-up. An adjustment of the tone controls gave the curve shown by the dotted line.

The last test we can make in this class is to find the effect the radio receiver has on our amplifier response curve. The test will, however, be beyond the means of most people unless expensive test gear is available. It will be evident that the audio-frequency response of a straight RF and detector receiver will be dependent on the radio frequency to which it is tuned, and several tests at varying wavelengths must be made to get a true impression of the performance.

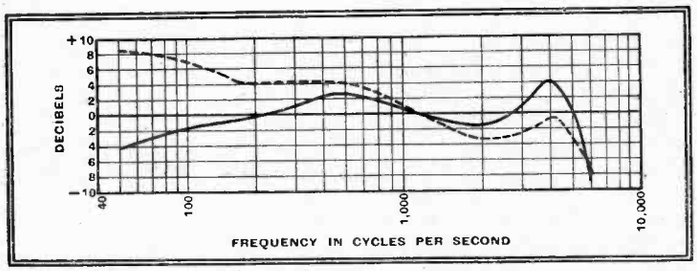
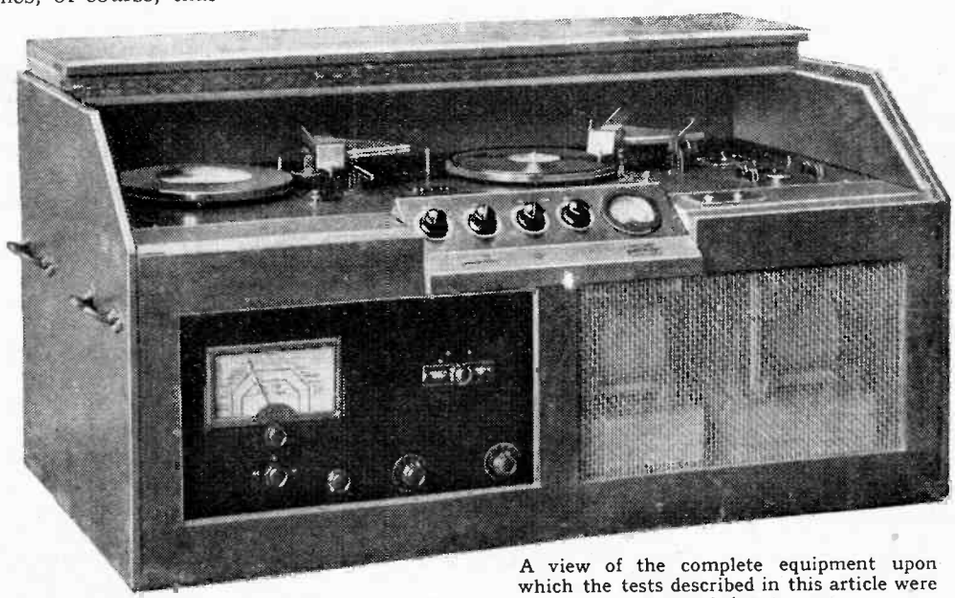


Fig. 5.—The response curves including a gramophone pick-up are shown here.

The apparatus required consists of a variable radio-frequency oscillator, an audio-frequency oscillator, a meter for showing the carrier intensity, and another for showing the percentage modulation of the carrier wave by the audio-frequencies, the whole equipment forming a standard signal generator.

The oscillators and receiver should be taken to a common earth while the link between the "transmitter" and the receiver must be via an artificial aerial, which has been standardised as consisting of a condenser, inductance and resistance in series as shown in Fig. 6, on which the required values are given. Resistance R is that of the output circuit of the RF oscillator which, in series with a resistance r must make a total of 25 ohms.

The procedure is much as before, it being necessary only to see that the carrier intensity remains steady and the percentage modulation is 30 per cent. throughout the audio range. The AF oscillator



A view of the complete equipment upon which the tests described in this article were carried out.

Testing PA Equipment—

frequency is varied while noting the readings of the output meter.

The London Regional and National wavelengths were selected for test on the U.C. equipment; the curves with tone

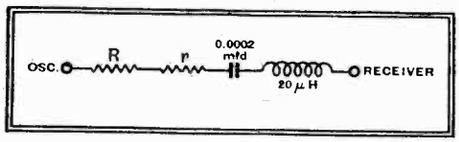


Fig. 6.—For radio-frequency measurements the RF oscillator is connected to the receiver through an artificial aerial which consists of the network shown.

controls in the normal position were as shown dotted in Fig. 7, while application of tone control produced the responses shown by the solid curves.

As a matter of interest it will be noted that in the case of the Regional curves a step-up of 14 db. is provided by the tone control at 10,000 c/s, a figure which is in very close agreement with the figure published by *The Wireless World* for the step-up for that frequency on their tone-control amplifier.

While we have the RF oscillator in mind we might deal with selectivity curves. These again are dependent on the frequency to which the receiver is tuned, as is well demonstrated if curves at more than one frequency are taken.

In this case the audio-frequency is kept constant at, say, 400 c/s, while the radio-frequency produced by the oscillator is "wobbled" on either side of the "transmitter" frequency in as small steps as possible, usually between 1 and 5 kc/s per step. Either constant input or constant output can be used to determine the selectivity curve, a fairly low constant output being preferable owing to the great change of signal strength that takes place. A reading of millivolts input is taken for each step and the decibel ratio found with reference to the input required to give the same output at resonance. If band-pass tuning is employed, a tendency towards double-humping will be noticed, while the fall of signal on either side of the humps will be rapid.

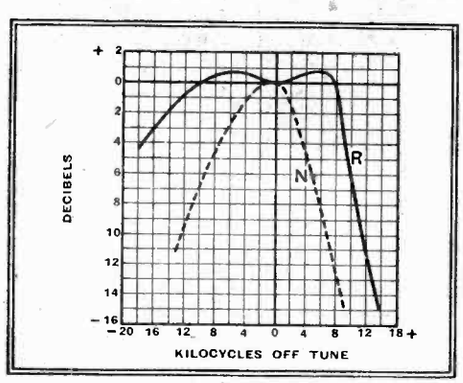


Fig. 8.—The selectivity curves at the National and Regional wavelengths.

Selectivity curves for the London National and Regional frequencies are given in Fig. 8. It will be seen that there is a slight out-of-balance between the two humps, due to errors in trimming. Unless cathode-ray and automatic frequency wobbling equipment is available, however, it is extremely difficult to obtain greater accuracy of balance than that shown except by chance, and in this particular case the discrepancy is probably insufficient to cause audible distortion of the received programme.

Returning to the amplifier proper, a figure frequently asked for is the overall gain. Readers of *The Wireless World* know now, if not before the recent discussion, that this term can be quite arbitrary when expressed in decibels, and if I may quote from an anonymous poem,

"We can make it what we will—
By discreet approximation."

Though a method of dealing with the subject has been explained, using decibel notation, the best method, long since adopted by *The Wireless World*, is to express the gain, not in decibels, which are

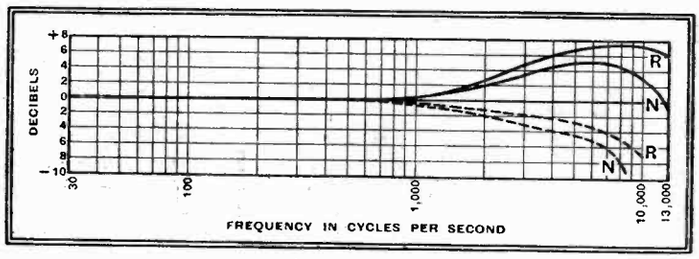
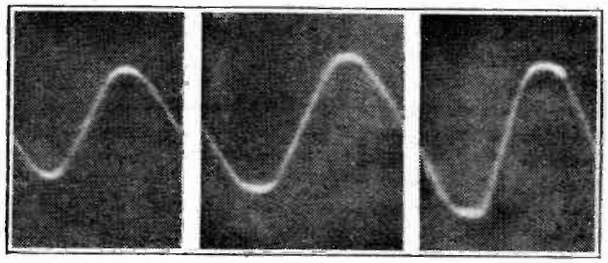


Fig. 7.—The overall response curves at the National and Regional wavelengths, without tone control (dotted lines) and with tone control (solid lines).

essentially a function of power and not of voltage, but in millivolts or volts input required to give maximum undistorted output. There is some doubt as to the method of determining the distortion point accurately, but when quality is a primary consideration, grid current is to be avoided, particularly in RC amplifiers. A micro-ammeter in the grid circuit of one of the output valves will show when grid current flows, and we can assume that (for triodes) the maximum undistorted output is reached when there is just no grid current.

Using the circuit shown in Fig. 3 (b), simply increase the input volts till grid current flows and then reduce the input till the current just ceases. The input voltage for this condition is the value required.

We now come to the determination of what, with the possible exception of frequency response, is the most interesting figure of all where PA amplifiers are concerned—the maximum undistorted power output. It was stated earlier that for triodes the maximum undistorted output is obtained when there is just no grid current flowing in the output valve. This, of course, assumes that the output valves are correctly biased and operated with the correct load impedance. With other types of output stage, notably pentodes, the grid current does not determine the distortion point. For such circuits a simple and interesting method consists of plotting input voltages against output voltage developed across the load, and so



(a) (b) (c)

Fig. 9.—These oscillograms show (a) the waveform of the output with no grid current in the output valves; (b) with 24μA grid current in the output stage; and (c) with heavy overloading.

long as the amplifier is distortionless, the result is a straight line, but when distortion occurs the output does not rise so rapidly, and there is a marked flattening of the curve when the overload becomes serious. This method has the advantage that it shows up any non-linearity at small inputs, and also any distortion introduced by valves other than those in the output stage.

Since Class A triodes were used in the tests described, the grid current method was used throughout.

With B amplifier and a 15.3-ohm load on the 15-ohm transformer secondary the input was increased until just short of the grid current point in the output stage. A voltage of 13.6 was read, which is equivalent to an output of 12.1 watts.

In practice it may be found that a slightly different result is given depending on which output valve the grid-current meter is inserted. The difference should be small, but if grid current is found to be flowing much earlier in one valve than the other, the anode currents should be checked for balance, and if satisfactory, then it is advisable to substitute the power valve with one that more closely matches its partner. If perfectly matched valves are used and the trouble still persists, then it indicates that the amplifier is unbalanced, and this can be checked by connecting a pair of headphones in series with a good condenser between the output transformer primary centre-tap and earth. Anything more than a faint signal shows unbalance, and the input balancing potentiometers, if provided, should be adjusted accordingly.

To conclude the tests it was decided to find what effect grid current had upon the output waveform. Either a Dudell mechanical oscilloscope or cathode-ray equipment is required with synchronous motor or linear time base respectively. The voltage output required will depend upon which equipment is used, but with a cathode-ray tube it will usually be found

Testing PA Equipment—

that the maximum voltage available will be needed. For my tests, leads were taken from the 15.3-ohm load on the secondary of the transformer to the Y plates of a cathode-ray tube, while the time base was connected to the X plates.

The time-base frequency should be made as high as possible to give a well spread-out waveform, and if photographs are to be taken, care must be exercised to ensure the stability of the time base.

Fig. 9(a) shows the waveform of a 400 c/s note as given by the amplifier just before grid current started to flow, that is, at about 12 watts. Increasing the input sent the valves into grid current, and when this had reached 24 microamps, equivalent to a little over 16 watts, the photograph 9(b) was taken, where surprisingly little distortion is noticeable. On a loud speaker the sound was unbearably loud, and an aural test for distortion rendered almost impossible. A further increase of input sent the grid current up to 83 microamps, giving the highly distorted waveform shown in Fig. 9(c).

Finally, three more useful hints:—

(a) Do not take it for granted that the calibration of a valve voltmeter will remain constant at all frequencies.

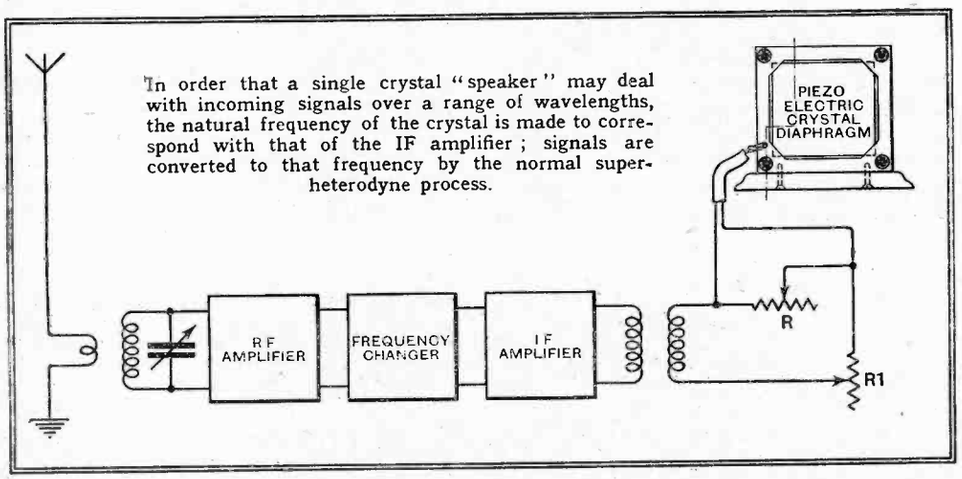
(b) After a frequency run, always return to the starting point—400 c/s, to check that no drift has taken place.

(c) Keep a watch on the mains voltage.

My grateful thanks are due to Professor R. O. Kapp and to Dr. Monteagle Barlow for permitting me to use the University College Communications Laboratories and apparatus for these tests.

Combined Detector-Loud Speaker

THE piezo-electric crystal is better known as a high-frequency oscillator than as a detector of wireless signals, though it seems that it can be made to serve both purposes simultaneously. For instance, the idea of rectifying high-frequency signals directly by a crystal which is, in effect, the diaphragm of a loud speaker forms the subject of a recent patent (No. 477623) issued to Standard Telephones and Cables.


In order that a single crystal "speaker" may deal with incoming signals over a range of wavelengths, the natural frequency of the crystal is made to correspond with that of the IF amplifier; signals are converted to that frequency by the normal superheterodyne process.
PIEZO ELECTRIC CRYSTAL DIAPHRAGM
R
R1
R F AMPLIFIER
FREQUENCY CHANGER
I F AMPLIFIER

The incoming signals, after RF amplification, are applied to a crystal approximately 1½ inches square and ⅛th of an inch thick. The natural frequency of a crystal of this size is roughly one million cycles a second, so that it is resonant to a carrier-wave of 300 metres. A close analysis shows that, in addition to vibrating at the carrier-frequency, the crystal will also follow audio-frequency variations in amplitude with sufficient fidelity to reproduce the original voice or musical frequency imparted at the transmitting end. In other words, the necessity for a separate detector or rectifier disappears.

The mechanical movement of the crystal surface is sufficient, having regard to the effective diameters of the molecules of oxygen and nitrogen which go to make up the surrounding air, and, having regard also to their "mean free paths" under ordinary atmospheric pressure, to create mass movements of air at the frequency of the audible signals, in much the same way as the piston strokes of an ordinary loud speaker diaphragm when subjected to the action of audio-frequency currents.

The necessity of using crystals of different size for receiving programmes on different wavelengths is avoided by cutting a single crystal to respond to the fixed intermediate frequency used on a superhet receiver, as shown in the accompanying diagram. The inherent frequency of the crystal being stable, this helps to increase the overall selectivity of the set and to cut out all forms of interference.

In order to pass the necessary side-bands, the crystal is deliberately damped by inserting shunt and series resistances as shown at R and R1. There is also a certain amount of frictional damping where the crystal is clamped to its mount.

SAPPHIRE NEEDLES

THE problem of how to dispose of worn steel gramophone needles is ever-present, and generally one either throws them away or puzzles one's brains to find some means of utilising them. This difficulty will no longer arise if sapphire needles are employed, and this is now possible, as an American firm has just marketed play-back needles for ordinary pick-ups consisting of a genuine sapphire tip on a bronze shank. The price is 3 dollars each (about 12 shillings). A life of at least 3,000 playings is claimed for these needles, combined with the advantages of reduced surface noise and record wear, due to the fact that no steel filings or burrs on the needle can embed in and damage the grooves.

The Telefunken pick-up, released in England some months ago, is believed to be the only commercial model using a sapphire needle (other than the Western Electric Company's "hill-and-dale" reproducer that has a permanent diamond or sapphire), but, of course, it is an integral part of the whole pick-up. This is probably the first time a replaceable sapphire needle has been made available to the public at a moderate price. The reason for the price of these needles, apart from the cost of the raw stone, is attributed to the work of the skilled lapidary required to shape and polish the tips, which can be done only with diamond dust.

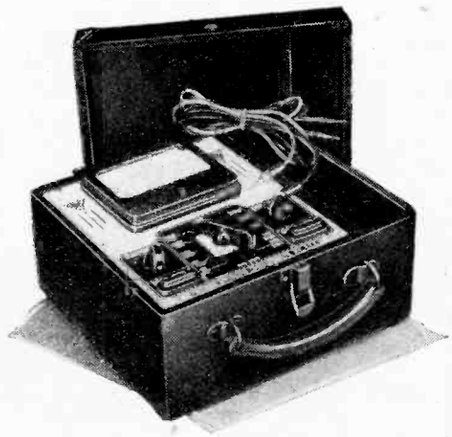
The address of the American firm making these needles is Electrical Laboratories Co., 49, East 21st Street, New York City.

PRECISION 840 METER

THE Precision 840 meter is handled by L. A. MacLachlan, of Strathyre, Perthshire. It is a multi-range AC and DC voltmeter and milliammeter and ohmmeter.

The voltage ranges are 10, 15, 250, 1,000 and 2,500 volts at 1,000 ohms per volt for AC and DC, while the current ranges are 10, 50, 250 mA and 1 amp. AC and DC. There are three ohmmeter ranges giving useful indication from about 1 ohm to 1 megohm.

A single rotary switch enables the desired range to be selected, and another two-way switch gives a change-over for AC or DC measurements. A variable resistance is provided for the adjustment of the ohmmeter ranges.



Precision multi-range AC and DC volt-milliamp-ohmmeter.

The meter is a good instrument, with a scale length of some 2⅝in. across the arc of the voltage and current scales. The resistance scales, being outside these, are longer, and the decibel scale, being inside, is shorter.

The instrument is contained in a black leatherette case with a compartment for test leads.

Return from Malaya

Empire Broadcasting from the Receiving End

MORE than two years have elapsed since the publication in "The Wireless World" of a survey of Empire Broadcasting in Malaya by the author of this article. On his return home after four years' absence he now records the progress that has been made in this increasingly important B.B.C. activity and offers suggestions for the development of the Empire Service

By "HEPTODE"

DURING the last year or two it has come to be generally acknowledged that Empire broadcasting is an essential service which should be given gratis to the Empire by the Mother Country. It was gratifying to overseas listeners that this principle was endorsed by the Ullswater Committee. From the radio engineering point of view, British short-wave broadcasting leads the world.

The B.B.C. Engineering Department has carried out a policy of steady development and has not hesitated to invite the co-operation of listeners during protracted tests of aerial arrays and frequencies. This period of development culminated in the bringing into service shortly before the Coronation of the new transmitters which are now giving greatly improved strength of reception and greater choice of frequency. The excellence of the service amazes listeners from England who are accustomed to the erratic reception there of American stations.

The strong and reliable reception obtained of the Empire Service in Malaya would seem incredible to anyone who had not experienced it. There is never a night when reception of the B.B.C. Service is not possible at some time during the evening and there are few nights when reception on an adequate receiver falls below entertainment value. Although it is difficult to imagine so progressive a body as the B.B.C. Engineering Department being satisfied that finality had been reached, there seems little left to be done by way of technical improvements. Perhaps the provision of sufficient channels for alternative programmes may be considered?

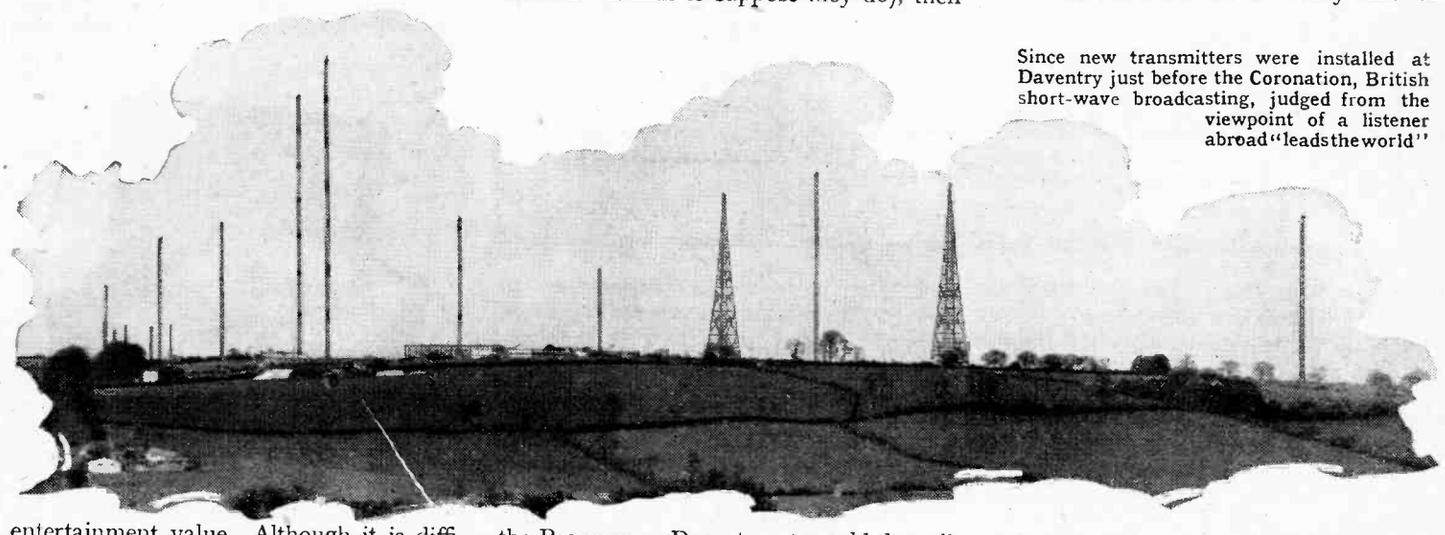
It is certain that the Programme Department do not use the facilities placed at their disposal by the Engineering Department to the best advantage. There appears to be lack of co-operation between these two departments at the B.B.C. The stated policy of the Programme Department is to give each part of the Empire a transmission primarily intended for it during the early evening. In pursuance of this policy, Transmission II is directed to Malaya so as to be heard there between 6.30 p.m. and 8.30 p.m. local time. Reception of the Empire Service is always better after 8.30 p.m., when the programme for Malaya has concluded. Broadcasting then continues in Transmission III (for India), and is usually received very much better than is Transmission II. It is particularly annoying to have the News Bulletin in Transmission II marred by bad conditions, which then improve to very good perhaps half an hour later. The next bulletin is not given until nearly midnight, local time.

Programme Times Need Revision

The Engineering Department must be well aware of this state of affairs and yet the Programme Department continues its efforts to reach Malaya two hours too early. If similar conditions prevail in other parts of the Empire (and the writer's experience in the earlier days of short-wave development in North America and India leads him to suppose they do), then the Programme Department would do well to reconsider the hours at which programmes are directed to particular parts of the Empire. Rather than arbitrarily deciding that every part of the Empire must be reached in the early evening and expecting the engineers to defeat Nature, it would be better to get the engineers to discover at what time they can best reach each part of the Empire with the apparatus at their disposal.

At present the B.B.C. relies upon official organisations and broadcasting bodies overseas for its reception reports. There is reason to believe that in many instances these reports are based on observation by unskilled personnel with inadequate apparatus. In any case there can be no consistency or uniformity in reports from many diverse bodies. The next step in the development of Empire Broadcasting must be a thorough investigation of receiving conditions in all parts of the Empire. The Engineering Department has admirably fulfilled the first part of its task and it must now be allowed to take to the field. Qualified men with full experience of short-wave technique should be sent out to give reliable and comprehensive reports of reception. They would also make contact with local listeners who would continue to carry out observations after they had left. Many listeners who are competent and equipped for making observations and who have long since ceased writing to the B.B.C. would be only too willing to co-operate if they were placed in personal touch in this manner. It is emphasised that the personnel of the Empire Departments field force must be engineers and not publicists.

If the use of a field force as envisaged is not possible, then there exists, in the



Since new transmitters were installed at Daventry just before the Coronation, British short-wave broadcasting, judged from the viewpoint of a listener abroad "leads the world"

Return from Malaya—

many holders of amateur transmitting licences throughout the Empire, a body of men who are fully versed in short-wave technique. These amateurs are capable of sending worth-while reports to the B.B.C. and have the means at their disposal to send them rapidly. If the P.M.G. could be persuaded to allow amateurs to pass messages addressed to the B.B.C., then the Empire's amateurs would have a useful and interesting work to carry out and live traffic to handle, while the B.B.C. would be able to obtain reliable reports from overseas with great rapidity.

During the last two years there has been a steady improvement in the Empire programmes, but they are still very, very inferior to the fare of Home listeners. Recorded programmes are employed more than they were, but they are still almost invariably recordings of special Empire Department programmes which have been given in the original in some previous period of Empire transmission.

Desperate efforts to avoid controversy spoil nearly all talks and what is left of interest is spoiled in delivery by the kindergarten diction imposed upon the speakers. This slow diction is also practised by the announcers. No doubt, under bad conditions or with poor receivers, slow speech helps listeners to understand what is being said, but when the periods of transmission are intended for reception only in areas where the service is of programme value at the time, it seems illogical to legislate for poor conditions. Under normal conditions of reception of the Empire Service in Malaya, it is just as easy to follow a talk on a good receiver after 9 p.m. as it is when listening in England to a medium-wave non-local regional station.

Photo courtesy The Malayan Information Agency.

Street scene at Kuala Lumpur, Malaya.

The Empire News Bulletins are still by far the best and most widely appreciated part of the programmes. Their greatest merit is their excellent continuity from day to day, reflecting very great care in preparation. In the local Press, only too frequently is some event mentioned in a brief cable and then nothing more is heard of it by those interested until the papers arrive from England three weeks later. In the Empire News an event is followed up daily until there is nothing more to be said about it. All the news is given much more fully than in the cables published in the local papers, making it much easier to regard events in their correct perspective. One defect is the growing tendency to include items of news originating from the region to which the transmission is directed. So far as Malaya is concerned such items are unnecessary because the local papers and local broadcast news bulletins cover all local events adequately. The B.B.C. should avoid any tendency to give the Empire to the Empire—what the Empire wants from the B.B.C. is Britain.

The question of broadcast propaganda is very much to the fore at the present time. Malayan listeners get full measure of tendentious news in English from foreign stations. There is no doubt that the Empire News Bulletins are an excellent antidote to some of this foreign "news." The broadcasting of these bulletins in foreign languages would certainly increase their antidote value, but it is to be hoped that this can be carried out without seriously curtailing the time available for normal programme matter.

Scope for British Enterprise

A few British manufacturers have entered the Empire market with effective apparatus, but the bulk of the receivers in use in Malaya are still of American origin. The success of Empire broadcasting in that part of the Empire has undeniably been built upon a solid foundation of American receivers. It is fortunate for the reputation of British receivers that none of the small all-wave sets now manufactured in England have as yet been tried in the Empire market. It is to be hoped that manufacturers and exporters will continue to show restraint in this matter. This small type of set with no RF stage, low sensitivity and a limited wave coverage is quite unsuitable for Empire listening. It fails in two essentials; it allows second channel interference on the shorter waves and it cannot give proper control of fading.

The fundamental specification of a receiver for Empire broadcasting must include a tuned RF stage for all wavelengths covered, two IF stages with an IF of the order of at least 465 kc/s, non-delayed AVC and power output sufficient for large rooms and open verandahs. For Malaya the receiver must tune down to 13.9 metres because this wavelength is well received during the greater part of the year. Reception on waves of this order requires good stability of oscillator frequency. There is nothing more exasperating than reception of 13.9 metres on a set with oscillator creep.

The best British receiver the writer was able to test before leaving Malaya was the G.E.C. "Fidelity All-Wave Eight." This receiver gave results under Empire conditions fully comparable with American ten-valve sets, and the specification and finish are really tropical. It is an interesting point that the set is fitted with valves of the so-called International Range which are equivalents of American types. It is a curious fact that some British receivers which appear to be as good as American sets from specification do not compare favourably with them on actual test.

Malayan listeners still suffer badly from interference by commercial stations with short-wave broadcasting. This is a matter which might well receive the attention of the B.B.C. engineers if they are sent out to study receiving conditions. Many complaints of interference can be traced to poor receivers, but there is still far too much real interference from commercial telephony, telegraphy and facsimile transmissions. The Berne list still shows stations with frequency allocations within the short-wave broadcast bands. Perhaps the Cairo Conference will evict these stations? The operation of very high-powered stations just outside the broadcast bands should also be restricted. Singapore appears to be in the maximum signal zone of the aerial array of station PLF in the Netherlands Indies, for at some seasons its signal, just outside the sixteen-metre band, causes a wipe-out of everything on that band, no matter how selective the receiver may be.

UNBIASED

BY

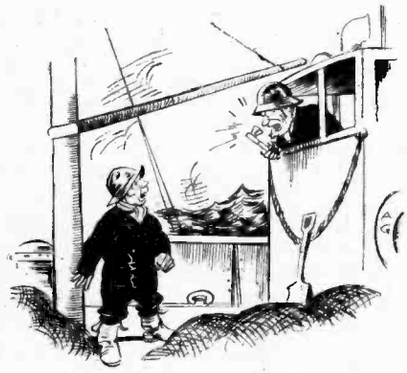
FREE GRID

Encouraging Crime

I SUPPOSE that one of the most despicable traits our frail human nature exhibits from time to time is that of eavesdropping. To my mind, it has nothing in common with the bold buccaneering spirit of olden days which made men murder their mothers-in-law and set sail in a tiny ship to attack the big treasure galleons of the Spanish Main. Not, mind you, that I am trying to defend piracy, but there is at least something wholesome about it which cannot be said of eavesdropping and similar underhand pastimes.

It is because I hold these sentiments so strongly that I have always deplored the fact that set manufacturers have never fitted muting arrangements to their products so that the set is silent when tuning past wavelengths reserved for ship and other commercial services. In the course of tuning, a set inevitably does pass over such wavelengths, more especially in these all-wave days, and, although I feel sure that all of my readers discreetly hurry by them, there are some people who, I fear, are base enough to stop and listen to private conversations even though they may not break the letter of the law and the terms of their wireless licence by disclosing what they hear.

As I have said, it has always troubled my spirit that manufacturers do not fit this form of muting to their sets, but I realise that it would mean extra production expenses, and in these hard times, of course, when the cost of keeping racehorses has risen to the pitch it has, manufacturers have to look at every penny. It



Private conversations.

has, however, come as a very deep shock to me to hear a rumour that one important manufacturer is contemplating putting out his standard all-wave models fitted to cover the trawler band of wavelengths.

Now, by no stretch of the imagination can it be argued that wireless telephony transmitters are established on trawlers for the purpose of radiating entertainment as in the case of broadcasting stations. If, therefore, no entertainment is being radiated from trawlers, for what purpose are broadcasting receivers to be made to cover trawler wavebands? Merely for the purpose of eavesdropping on private conversations as far as I can see. What is worse, many listeners may be tempted to retail some of the trawler conversations to their friends as they often are, as I can personally vouch for, very entertaining indeed, although unintentionally so.

This would, of course, constitute a definite breach of the terms of a wireless licence, and make the offenders liable to prosecution under the provisions of the various Wireless Telegraphy Acts. These rumoured trawler-band sets would thus act as a deliberate temptation to a breach of the law which, as all right-thinking people will agree, is a very bad state of affairs indeed. I trust, therefore, that the manufacturer concerning whom I have heard these rumours will either reconsider his decision or write to reassure me that it *is* only a rumour, on receipt of which I shall be very pleased to apologise.

One Thing After Another

A GRATIFYING large number of you responded to my recent appeal for advice as to the best method of tunnelling underneath neighbouring gardens in order to link my house, by means of a low-impedance transmission line, to an aerial erected in a nearby field.

The suggestion which I eventually adopted was that I should dig a hole in my garden and a corresponding one in the field. In the latter I was to dump a sackload of rats, a number of ferrets being released in the garden hole. The ferrets, which my informant was willing to sell me, possessed, he said, a very keen direct-line scent and would at once commence to tunnel through to the rats in the other hole, as it would not occur to their limited intelligence to climb out of it and travel overland.

The ferrets duly arrived, but owing to the difficulty of getting a quantity of rats I was compelled to keep them for a few days in the house, a fact which caused the strong disapproval not only of Mrs. Free Grid but also of neighbouring residents, as these animals possess to some extent the well-known properties of the skunk. In the end I was able to obtain some rats by negotiating with a local ne'er-do-well who was recommended to me as a specialist in this sort of thing. The delivery of the sackload of rats on my doorstep occasioned great excitement among the dogs of the neighbourhood, many of them having to be dragged forcibly from my garden by their indignant owners, and I fear that the social standing of Mrs. Free Grid and myself in the neighbourhood, which was already somewhat shaky, underwent a still further decline.

Eventually, however, the sack of rats was safely dumped in the hole dug in the field and I put the ferrets down the garden hole in order that they might commence their great work in the cause of applied science. Unfortunately things went wrong right from the start, as the first ferret to be released seemed a badly trained animal, and, instead of commencing his allotted task of tunnelling, promptly took refuge in my trouser leg. The immediate effect of this was that I received a very severe bite, but this was by no means the

"... took refuge in my trouser leg."

worst as, in my pain, I accidentally kicked over the ferret box, this causing the lid to fly open with the result that all the animals escaped into neighbouring gardens and are still at large. For the past few days the whole district has been in a state of siege, the women not daring to venture into their gardens and the menfolk being compelled to search their respective houses thoroughly at night before the household retires to rest.

To crown all, when I went to the hole in the field, I found that the rats had eaten their way through the sack and had spread themselves over the adjacent farm buildings. Needless to say, my social status in the neighbourhood has now sunk to the absolute zero mark, but it has at any rate had one good effect, as it has enabled me to re-erect my garden aerial, as it is quite obviously impossible for it to cause my prestige in the neighbourhood to go *below* absolute zero.

Bouquet for Manufacturers

IT is gratifying to find that my words carry so much weight with manufacturers. This is strikingly exemplified by their promptness in responding to my recent appeal for the marketing of a "playing desk" fitted with an automatic record changer. Two prominent firms have already produced these articles in response to my request, and I understand that a third is making plans to market one which will deal also with the popular 9in. records. As yet, however, there are no signs of the 12-guinea radiogram which I asked for, but I realise, of course, that this takes somewhat longer to design.

Television Relay Systems

IS "WIRED" TELEVISION PRACTICABLE?

IT has been suggested that television programmes might be distributed to viewers by methods similar to those adopted in certain areas for relaying sound broadcasting by wire to listeners. The technical possibilities of this suggestion are critically examined in this article.

IT is often argued that the cost of a sound broadcast relay system to the individual listener is less than that involved in the use of a receiver, for the only apparatus he requires is a loud speaker. If the standard of quality is of a mediocre order, this may be true, but it is doubtful whether it is the case when a high standard of quality is maintained. The relay equipment must then be of much higher quality, and, more important, the relay lines are much more costly. All this increase in cost must be borne by the subscriber in his regular payments.

Now in respect of television the suggestion is sometimes put forward that a similar distribution scheme might be adopted, presumably with the idea that it would enable a great saving in cost to be effected. Those who favour such a scheme seem to believe that because in a sound relay system it is only necessary for the subscriber to have a loud speaker connected to the incoming two-wire line it would in a television system be necessary only to have a cathode-ray tube connected to the line. This is actually very far from being the case, and it will be instructive to examine the possibilities.

To produce a picture the cathode-ray tube must have a heater supply of some 2 to 4 volts at 1 to 2 amperes, a high-voltage supply of 3,000 to 6,000 volts at a few microamperes, and lower voltages at negligible current if electrostatic focusing is used, or some 50 mA. at 50 volts if electromagnetic focusing is adopted. With the exception of the heater supply, these must all be direct current, and it is obviously impracticable to supply them directly from a relay station. In practice they would have to be derived from the lighting mains with the aid of the usual transformer, rectifier and smoothing equipment. In addition to the CR tube, therefore, each subscriber would have to provide at least a high-voltage unit similar to that included in all present television sets.

In addition to these steady voltages and currents the CR tube requires saw-tooth voltages or currents with basic frequencies of 50 c/s and 10,125 c/s for scanning. The channels over which such frequencies are passed must have an even frequency response up to some ten times the fundamental frequency. That is, two channels must be provided for the scanning, one of 50-500 c/s and the other of 10,125-101,250 c/s, and these channels must exhibit remarkably little frequency and phase distortion over these bands. For electrostatic deflection the saw-tooth waveform must have a peak-to-peak amplitude of about 1,000 volts, whereas for electromagnetic deflection a current amplitude of about 100 mA. p-p. is needed.

For modulating the tube there must be a vision channel capable of providing an output of some 10-30 volts p-p., and the frequency response must be such that frequencies from zero to 2,000,000 c/s are evenly reproduced; the phase distortion must also be very low.

In addition to the purely television signals there is also the sound channel to be considered. For this a frequency response of, say, 30 c/s to 10,000 c/s is needed for high quality.

An eight-wire cable system is the obvious suggestion for the linking of the relay station to the individual houses, but it is very doubtful whether this would be satisfactory for more than quite short distances. The signal levels on the lines would be of quite large values, and it would probably be very difficult to avoid cross-talk. Even for short distances the necessary cables would be very expensive.

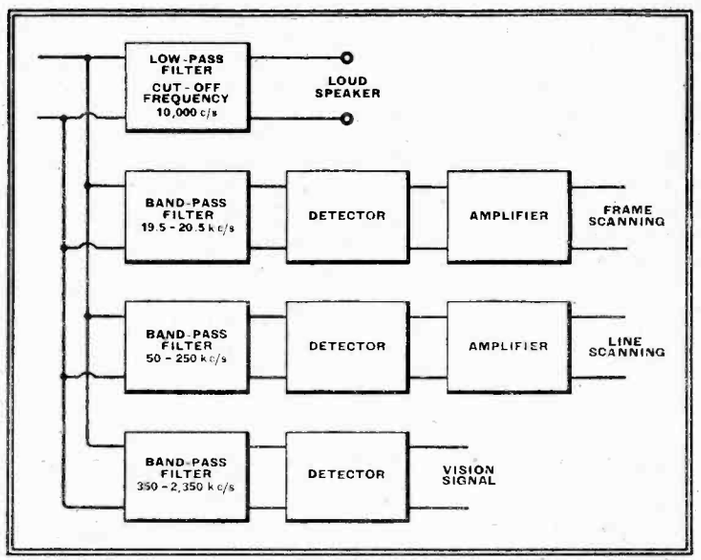


Fig. 2.—The receiving apparatus needed for the carrier system is depicted in this diagram.

An alternative method would be to use a single pair of wires only and to adopt the carrier system. There are many possible ways of arranging this, and the most obvious is to transmit the sound at audio-frequency, as in any other relay system, with three carriers for the three necessary vision signals. A band of 30-10,000 c/s would thus be reserved for sound.

The frame-scanning wave would be used to modulate a carrier, and a band-width of not less than 1 kc/s would be needed. The carrier might have a frequency of 20 kc/s.

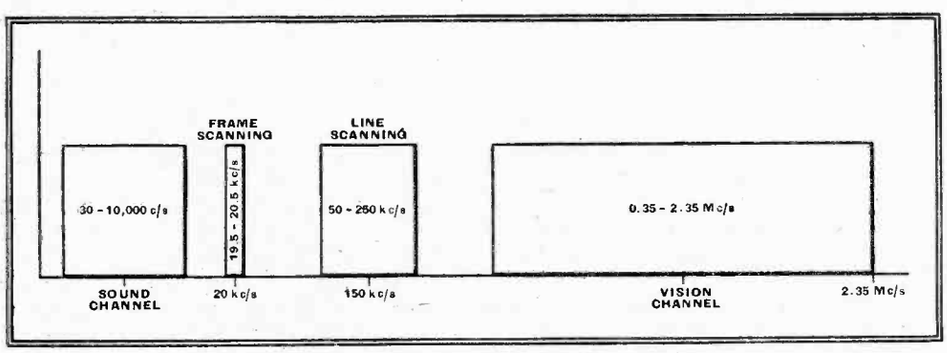


Fig. 1.—The bands of frequencies which would be needed for the distribution of sound and vision by the carrier system are indicated here.

Television Relay Systems—

The line-scanning wave would modulate another carrier, but this time the band-width would have to be 200 kc/s. The carrier could then hardly be lower than 150 kc/s.

The vision signal contains frequencies up to 2 Mc/s, and for double-sideband working a band-width of 4 Mc/s would be needed. Single-sideband working is feasible, however, and would reduce the band required to 2 Mc/s only. A certain gap must be left between the edge of this band and the upper sideband of the line-scanning channel. The latter is 250 kc/s, and the minimum gap is probably about 100 kc/s for reasonably easy separation of the signals in the receiver. This makes the vision channel extend from 350 kc/s to 2,350 kc/s.

The Receiving Equipments

The arrangement of the channels is probably most easily visualised from the drawing of Fig. 1, which is not to scale. The relay system must have a level response from 30 c/s to 2.35 Mc/s to accommodate all four channels. The energy level of the transmissions cannot be very high if cross-talk is to be avoided, and, consequently, amplification at the receiving end is likely to be needed.

At the receiver the minimum equipment is shown in Fig. 2; this is, of course, in addition to the CR tube and high-voltage supply unit. This minimum equipment supposes that the signal level is sufficient for operating the loud speaker directly and for modulating the CR tube after detection. If it is not, additional amplifiers would be needed on these channels.

The arrangement obviously does not lead to the use of very simple receiving apparatus, and it is probable that in a practical case no attempt would be made to transmit the scanning waveforms. These would be generated locally by time-bases just as in present-day receivers, and the vision signal would include synchronising pulses. Only two channels would then have to be provided, i.e., for sound and vision. The sound channel would be at audio-frequency, and quite a simple filter would suffice to separate the vision signal from it. The vision signal would include sync pulses of the present type, and could be transmitted in a band of 100-2,100 kc/s, and possibly at a level sufficient to modulate the tube directly after detection. Quite a simple filter would suffice to cut out the sound.

An amplitude filter for separating the sync pulses from the vision signal would be necessary, however, as well as the line and frame scan time-bases, their power supply unit, the CR tube, and its high-voltage supply unit.

It will be seen, therefore, that the apparatus required in the home would in reality consist of a present-day television receiver less the aerial and pre-detector stages of the vision and sound receivers. The mains equipment could also be reduced in size, because there would be fewer valves to operate. In place of this apparatus, there would be special filters and the special cable to the relay station.

In general, the vision and sound receivers are the least expensive parts of the television equipment. It is in the CR tube, the high-voltage unit, and the time bases that the major portion of the cost lies, and it is just these parts which would have to be provided by the viewer in a relay system. On the whole, therefore, it would seem that there is little to choose in the matter of cost between the relay system and the present wireless methods.

In the matter of interference, however, there may be some benefit, particularly at a considerable distance from the transmitter. This benefit, however, should not be overstressed, for it is actually quite possible for cable links to pick up interference. The avoidance of such pick-up is quite a difficult problem in wide-band cables of the type necessary for television purposes, and it is doubtful whether the few cables of this type in existence have been in use long enough to give a full knowledge of their capabilities.

We must conclude, therefore, that a television relay system hardly seems a practicable proposition, and it is very doubtful whether it will become so in the future. If we accept this conclusion, as we must, it brings us to another point in connection with sound relaying. The time will come, and sooner than many think, when sound broadcasting without vision will be considered as much of an anachronism as a silent film is to-day in the world of the cinema. The evolutionary process of the talkies will be reversed, and people will demand that sound broadcasting be accompanied by vision.

Vision, as we have seen, cannot be considered a practicable proposition on a relay system, and so those who take their sound programmes *via* such systems will be obliged to install wireless equipment for the reception of vision signals.

Books Received

The National Physical Laboratory: Report for the Year 1937.—A survey of the activities of the N.P.L. in various fields. In our own particular sphere the work of the Radio Department covers a wide range of fundamental research, mainly concerned with propagation and its relation to communication and direction finding. The measurement of field strength, the design of RF oscillators of stable frequency, visual indicating direction-finders, and other matters, are discussed in the Report. Pp. 150; published by H.M. Stationary Office, Kingsway, London, W.C.2. Price 2s. 6d.

The Broadcaster Radio and Gramophone Trade Annual, 1938. Pp. 224, with numerous diagrams. The Wireless Retailer and Broadcaster, 29, Bedford Street, London, W.C.2. Price 5s., post free.

Broadcast Programmes

FEATURES OF THE WEEK

THURSDAY, APRIL 7th.

Nat., 6.20, "Forgotten Anniversaries"—talk by the Hon. Harold Nicolson on Dick Turpin. 7.30, The Band of H.M. Scots Guards. 8, Geraldo and his Concert Orchestra. 9.20, Weather Talk by Lord Dunboyne.

Reg., 7.30, "Cotton"—how the industry is managed. 8.15, The Royal Philharmonic Society's Concert at the Queen's Hall, conducted by Sir Thomas Beecham.

Abroad.

Marseilles, 7.30, The Elizabethan Song—Shakespeare, Ben Jonson, etc.

FRIDAY, APRIL 8th.

Nat., 8, Commentary on the Snooker World Championship Final at Thurston's Hall. 8.20, Dave Frost and his Band. 9.20, B.B.C. Concert of Contemporary Music—VII.

Reg., 8, Scotland—life in the Cromarty Firth. 8.30, Aileen Bransden at the B.B.C. Organ. 9, The Fol-de-Rols.

Abroad.

Brussels, 7, "The Daughter of the Regiment," operetta (Donizetti).

Beromunster, 8.10, "Titus," opera (Mozart).

SATURDAY, APRIL 9th.

Nat., 2.25 and 4.45, Commentary on the Motor-racing at Donington Park. 2.55, England *v.* Scotland—commentary on the International Association Football Match. 8, Music Hall. 9.20, American Commentary.

Reg., 7.30, The Perth Theatre Company in "The Barretts of Wimpole Street." 9, Peter Yorke and his Orchestra. 9.30, The Pig and Whistle—a rural episode.

Abroad.

Prague, 7, "The Gipsy Baron," operetta (Johann Strauss).

Bordeaux, 7.30, "Faust," opera (Gounod).

SUNDAY, APRIL 10th.

Nat., 5.20, Constant Lambert conducts B.B.C. Orchestra (E) with Jean Pougnet, violin. 6.30, Troise and his Mandoliers. 9.50, "Overture and Beginners, Please"—programme by the Theatre Orchestra with singers from the Chorus.

Reg., 6, Eugene Pini and his Tango Orchestra. 6.30, Sir Adrian Boult conducts Sunday Orchestral Concert, with Clifford Curzon, pianoforte.

Abroad.

Radio-Paris, 8.30, "La Croisade des Enfants"—oratorio (Pierne).

Naples Group, 4.30, "La Gioconda," opera (Ponchilli) from the Royal Opera, Rome.

MONDAY, APRIL 11th.

Nat., 7, Monday at Seven. 8.20, Kerbside Music-makers. 8.40, "The Gang Smasher"—serial, No. 2. 9.20, World Affairs.

Reg., 6, Montague Brearley and his Orchestra with Alan Paul, pianoforte. 8, Discussion on the Future of Lancashire Cotton. 9, Anna Neagle supported by Herbert Wilcox, Stuart Robertson and Kay Stammers in "Star Gazing."

Abroad.

Brussels, II, 8, "Black Violets," opera (Leo Fob).

Paris, P.T.T., 8.30, Basque Folk Lore.

TUESDAY, APRIL 12th.

Nat., 7, Anna Neagle in "Star-Gazing" (repeat). 9.20, America Speaks. 10.15, "Cabinet of Dr. Caligari"—an adaptation of the early film thriller.

Reg., 6.35, "Stop Dancing"—for new tunes and old. 8, Variety from the Holborn Empire. 9, Handel Programme relayed from Stuttgart.

Abroad.

Milan Group, 9, "Cleopatra," opera (La Rosa Parodi).

WEDNESDAY, APRIL 13th.

Nat., 6.40, Band Waggon. 8, Skittles Commentary. from Tower Hill. 8.15, Stanelli's Bachelor Party. 9.40, Boxing Commentary—the final stages of the Imperial Services Boxing Association Tournament.

Reg., 7.30, "The World Goes By." 8, Gounod's opera "Faust"—the B.B.C. Chorus (C) and the Theatre Orchestra, conducted by Stanford Robinson; narration spoken and written by Wilfrid Rooke-Ley.

Abroad.

Berlin, 8, Film Music.

Rennes, 8.30, Beethoven and Wagner Concert from Nantes.

Timing London's Buses

RECORDING MOVEMENTS BY INDUCTION SIGNALLING

THE recording of the "headway," or distance between successive vehicles, is an important detail of passenger transport organisation, and in the case of tube trains, trams and trolley-buses, clock-driven recorders have been successfully employed by the London Passenger Transport Board for some time. All these vehicles, however, have some electrical connection with a rail or power wire, but a bus is a completely independent unit. This makes the recording of its passage past any given point—and consequently the organisation of an evenly spaced service—a much more difficult matter. With the object of overcoming this handicap, a system of induction signalling, which is now in experimental use on Route 44, has been devised.

Although radio is not used as a link with the moving bus, wireless technique is employed in the associated amplifiers, etc. The signalling equipment on the bus comprises a 15-turn coil mounted in the roof, which is energised by a vibratory generator actuated by the 12-volt accumulator of the vehicle. The vibrator is of the tuned reed type, matters being so arranged that one pair of contacts interrupt the current passing through the primary of a transformer, which is tuned to the frequency of the reed.

At appropriate points along the route are installed "receiving stations" comprising a pick-up coil (with 100 turns of wire) which, in the case of the experimental installation, covers the full width of the road. This is because the pick-up coil is installed in the forecourt of Victoria Station, where one-way traffic is in operation. A half-width loop would, of course, be used on two-way roads, in order to avoid the recording of vehicles travelling in both directions.

In association with the receiving loop is an amplifier, through which impulses picked up from a passing bus are transmitted *via* telephone cable to the control station, where, after further amplification, they are passed through a selective tuned amplifier and made to actuate the relay of the headway recorder. This instrument may be installed at Headquarters or any other point; moreover, duplicating dials can be connected as required.

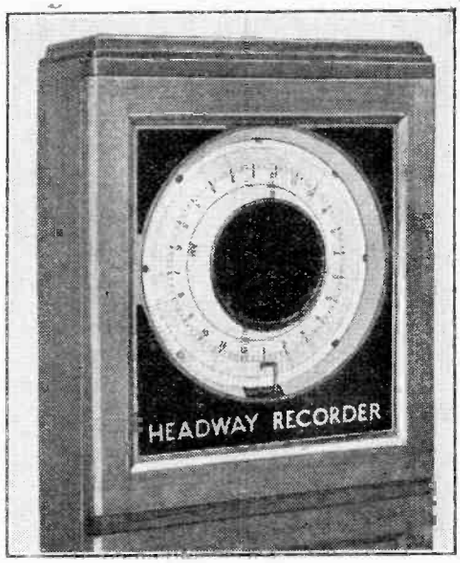
The recorder is very similar to that used for tube train working, and is fitted with a powerful clock mechanism which rotates a paper dial. Each impulse causes an inked hammer to imprint a bar-shaped marking on the dial margin, and, as the hammer is in line with the "correct time" pointer on the recorder, the marking indicates the exact time at which a bus passes under the coil at the checking point.

By making provision for selective tuned amplification of the received impulses, it becomes possible to use a single pick-up coil for recording the passage of buses on more than one route. The vibrator generators on each route would be tuned to a characteristic frequency, and the headway recorder for a given route would be actuated only by received impulses of the frequency to which its associated amplifier was tuned.

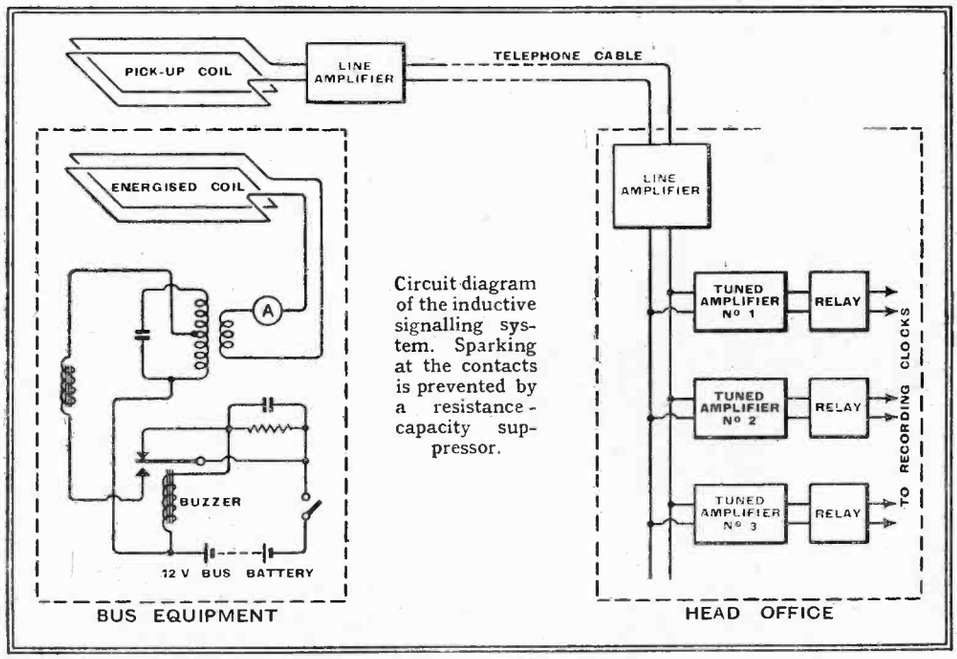
Twenty-four-hour dials are used on the recorders, and at the end of the day the paper disc is removed and filed for reference. Thus any irregularities in the service can be studied in detail, and such matters as recurring delays on certain days can be discovered and their causes investigated.

The apparatus on the buses is designed to stand rough usage, and is mounted in a heavy cast aluminium case. An ammeter is fitted, as shown in the accompanying diagram, to provide a check on feed current to the roof coil.

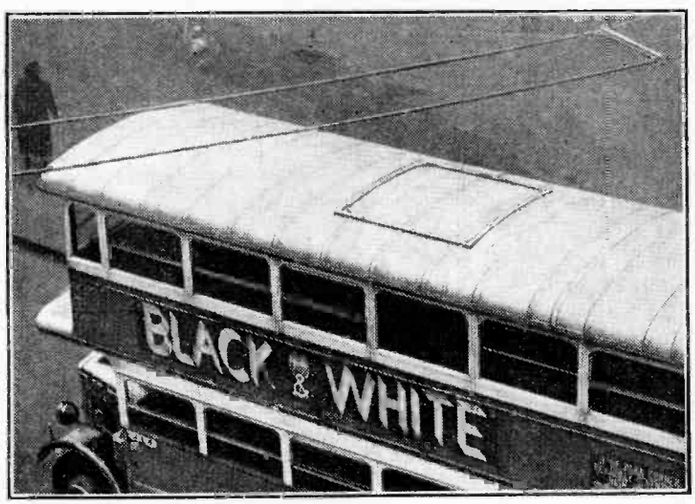
The accompanying illustrations are reproduced by courtesy of the L.P.T.B., to which thanks are also due for information and assistance in the preparation of this description.



The recording apparatus, as installed at headquarters.



Circuit diagram of the inductive signalling system. Sparking at the contacts is prevented by a resistance-capacity suppressor.



A bus passing under the pick-up coil; the "transmitting" coil is mounted in the roof.

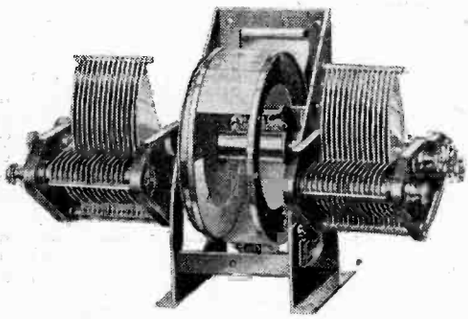
Practical Aspects of Design

II.—MECHANICAL COUPLING AND GANGING

By R. H. WALLACE

THERE is a tendency—quite a natural one—for many electrical engineers and wireless enthusiasts to avoid, as far as possible, the use of mechanical devices where an electrical method can be used, even if the latter costs much more and is far more complex. This viewpoint was no doubt fostered in the earlier days of wireless by the very flimsy devices then produced, and the clumsy appearance of them; the earliest ganged condensers measured anything up to a foot long by six inches square, and were even then subject to large errors.

Experiences with components of this nature led many wireless technicians to suppose that backlash, bulk and lack of reliability were essential concomitants of mechanical couplings. That this should not be the case will be obvious if



An early ganged condenser; although satisfactory enough for the "semi-ganged" sets of its period, the frame and vanes were liable to distortion. Note absence of split vanes for adjustment.

thought is given for a moment to the more familiar machines of everyday life. Take the watch, for instance; a comparatively cheap one will keep time within half a minute a week, an accuracy of 0.005 per cent. What would be the cost of an electrical oscillator of similar performance? Nor are all electrical circuits free from such evils as backlash. The ordinary reaction circuit comes to mind in this connection, as, if great pains are not taken, there is considerable backlash. It should not be forgotten that, in general, the electrical equivalent to a simple mechanical coupling will be a much more complicated affair. Another objection often raised against mechanical methods is that regular oiling and attention is needed, which it is implied the electrical substitute does not require. This is definitely not the case, and properly designed and lubricated bearings will run for years with the use given to them in a wireless set, while it will be surprising if the electrical side does not require more frequent attention.

The wise designer and builder will use both methods, each where it is the most efficient and the result will be both a cheaper and a better design. It is the intention of the writer to show in this article how the mechanical devices known to engineers may best be applied. There is one important feature of the mechanical coupling which is often of great value, and that is the fact that the whole of it may be earthed if desired. This makes it possible to carry the control through, or into places where conducting wires could not be used, and makes it possible to avoid the loss due to the screening of leads. A good example of this is the ordinary radio-gramophone switch. Unless great loss of sensitivity is accepted the leads for this cannot be screened, and it is frequently most convenient to place the valve in the grid circuit of which it is located at the rear of the set. Many people therefore put the switch at the back also, and put up with the inconvenience of this position, although it is easy to keep the switch by the valve and extend the control to the panel—the natural place to find it. This may not be possible by means of a straight rod, as there may be components in between the desired position of the knob and the best position of the switch. Here the device known as a universal coupling comes in, permitting the two spindles to be inclined and yet coupled effectively to each other.

Thus the switch may be placed at an angle, so that its extended spindle passes between the components, the coupling being used to connect it to the knob. Note that the spindles must be so arranged that they would intersect if produced. The drive can, if necessary, be taken right round a component by the use of two of these couplings.

IN the first instalment of this article the author discussed the general design of a wireless apparatus from the purely mechanical point of view. He now goes on to describe the less common applications of mechanical principles to receiver construction.

Compensating Couplings

Where it is desired to connect two spindles, nominally in line, which may be somewhat out of alignment, then two devices are available, according to the nature of the error; these are shown in Fig. 2 and Fig. 3. In the case of a ganged condenser, for instance, should it be necessary to mount it on rubber and yet to fix the slow-motion drive rigidly, the use of the coupling shown in Fig. 2 will permit a relative movement of as much as one-eighth of an inch, while still, if it is carefully made, giving correct angular drive. Where, however, the error may be of the kind where the spindles may be slightly inclined to each other, the coupling shown in Fig. 3 is the one to use; this is also of value when it is necessary to insulate the two drives from one another.

In cases of spindles at right-angles which have to be connected to each other, two alternatives are possible, according to whether they are to rotate by an equal amount or a change of movement is required. Where equal ratio is desired then the conventional type of bevel gear will perform the change, but if a change of ratio is wanted then a crown wheel and pinion is the right gear to use; the ratio of movement is inversely as the number of teeth on the gears. It must not be forgotten that where the power to be transmitted is small, as it usually is in wireless work, the gears need not be toothed if some slip is not objectionable, thus it is quite permissible to use wheels faced with rubber or cork where the knob does not indicate, as in a tuning drive.

Skew and Worm Gears

Where the spindles do not intersect, as they must for the cases just quoted, then skew gears can be used, but, since they require designing specially for each particular case, are costly unless used in quantity; the familiar worm gear can take their place if a large reduction can be permitted, otherwise it is often possible by repositioning the component to incline them so that their axes do interseet.

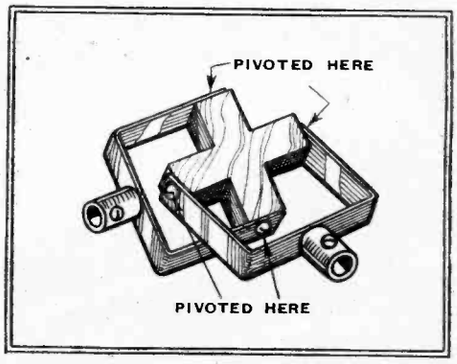


Fig. 1.—Universal coupling for spindles inclined to each other by angles between 180 and 145 degrees. The crosspiece may be of insulating material if necessary.

Practical Aspects of Design—

Cord drives have their particular uses, chiefly for slow-motion dials. They have the advantages of lightness and cheapness, and can be arranged very easily; wire is better for them than cord, and some form of tensioning device must be adopted to take up the stretch which occurs even with steel wire.

A coupling that the writer has rarely seen applied, but which has its special virtues, is the cam. This is used where the relationship between the two devices to be ganged is not a simple ratio, and may even obey no definite law.

Correcting Errors

For example, for special apparatus it may be desired to correct the residual error of a ganged condenser, or to ensure equal band-width or constant reaction at different frequencies, all of which require an irregular compensation; a small condenser operated by a cam on the main spindle will permit this to be done and small departures to be corrected. This method is particularly easy for the amateur, as the cam is easy to make and can be calibrated *in situ*; the rest of the parts of the control should be made and a piece of card affixed to the spindle in place of the cam, the main dial is then rotated step by step, the subsidiary condenser being set to the best

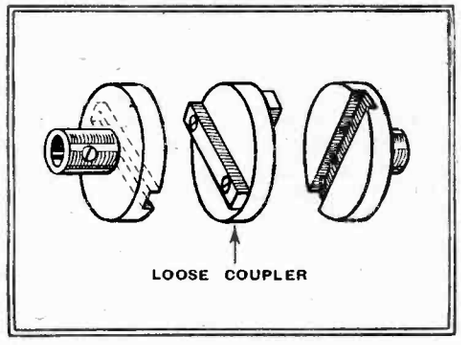


Fig. 2.—Coupling for parallel spindles misaligned, with parts dismounted to show action. The dogs must be a good sliding fit in the guides.

position each time, and the position of the roller marked on the card. When the job is completed the cam is cut to the marked line and then fixed on the spindle in the correct angular direction corresponding to the original marking.

The grub screw, simple as it is, may often be responsible for trouble. When used on round spindles the screw frequently slips, even if pointed, and it is the author's practice to countersink the spindle with a small drill at the right place so as to afford a proper seating for the screw. This is a little more trouble than simply screwing it in, but is well repaid afterwards.

Although the suitable ganging of controls is of great value this should not be carried out indiscriminately. As has often been pointed out in *The Wireless World*, the ganging of the on-off switch to the volume control subjects the latter to an undesirable amount of use. The writer is a strong adherent of the "one knob one purpose" school for this and other reasons, the coupling of too many controls does lead to mechanical complication, and is generally less reliable than independent controls, and also more awkward to repair when out of adjustment.

Finally, a word about lubricants. There is no reason why the purely mechanical devices should not be treated with a good clock oil, so long as it is kept

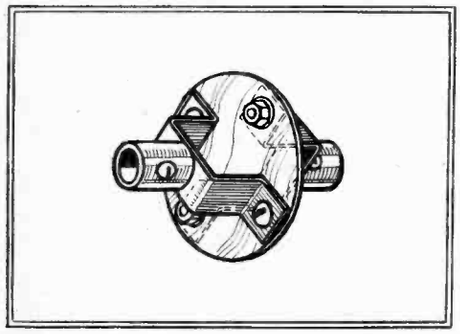


Fig. 3.—Flexible coupling for spindles very slightly inclined. This is the usual commercial pattern, generally made with a paxolin disc.

to them, but bearings which carry a current should be lubricated with something that will not increase the resistance of the circuit. Vaseline is often used, but a much better choice is something which is an actual conductor, namely, graphite, more commonly known as blacklead.

These observations do not by any means exhaust the field of inquiry, but it is hoped that they will be sufficient to indicate the principles, and the reader can apply them to the various cases that confront him; intelligently used with due regard to the other considerations involved this will improve both the reliability and the ease of operation of the apparatus.

Club News

Kingston and District Amateur Radio Society

Headquarters: The Three Fishes Hotel, Richmond Road.
Meetings: Alternate Wednesdays at 8 p.m.
Hon. Sec.: Mr. D. N. Biggs, 44, Pooley Green Road, Egham.

On March 16th Mr. J. F. Stuart-Williams gave a lecture on the oscilloscope. Modulation patterns of many amateur and commercial telephony stations were studied by members.

On April 13th a lecture on quartz crystals will be given by Mr. Didagan, of the Quartz Crystal Co.

London Transmitting Society

Headquarters: 40, Raeburn Road, Edgware.
Meetings: Thursdays at 8 p.m.
Hon. Sec.: Mr. G. Yale, 40, Raeburn Road, Edgware.

On March 24th members visited the Golders Green Society and enjoyed a lecture by Mr. Blake.

The Society now has fifty members.

Exeter and District Wireless Society

Headquarters: 3, Dix's Field, Exeter.
Meetings: Mondays at 8 p.m.
Hon. Sec.: Mr. W. J. Ching, 9, Sivell Place, Heavitree, Exeter.

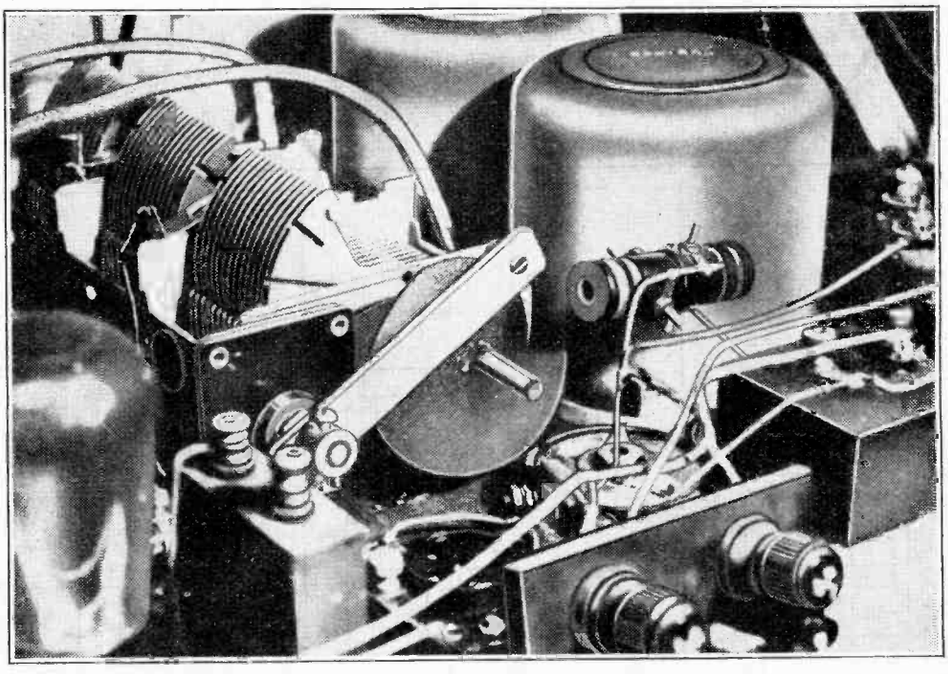
On March 28th Mr. H. A. Bartlett conducted a "Questions and Answers" evening. The questions were chosen from a recent examination paper set by the New Zealand Government for intending amateur transmitters.

The subject of the next lecture is "Telegraphs, Wire and Wireless." Mr. H. Ridge will be the lecturer.

Croydon Radio Society

Headquarters: St. Peter's Hall, Ledbury Road, South Croydon.
Meetings: Tuesdays at 8 p.m.
Hon. Pub. Sec.: Mr. E. L. Cumbers, 14, Campden Road, South Croydon.

At his lecture entitled "Progress in Commercial Receiver Design" Mr. Marks stated that only five manufacturers produced a really reliable receiver. In one case, he said, a receiver arrived from the factory duly passed as "O.K." but with no loud speaker fitted. He emphasised these points to bring home his views on the defects of mass production. He envisaged the time when only qualified engineers would be employed by manufacturers. Sets at nine guineas were far too cheap, he said, as the amount of knowledge involved was not saleable at that figure.

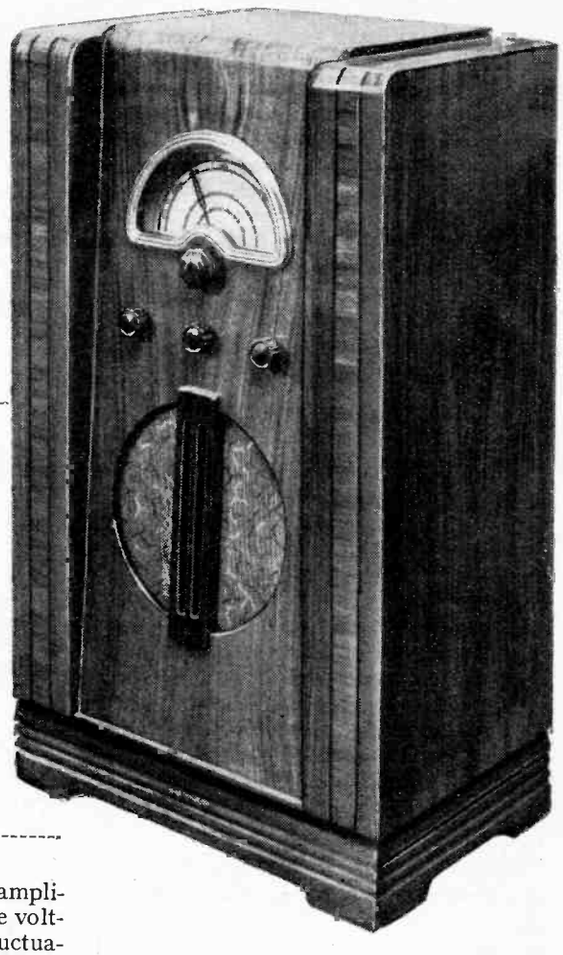


The use of a cam for obtaining constant reaction. An insulated cam is fixed to the spindle of the main condenser, while the small condenser spindle carries an arm having at its end a roller which runs on the edge of the cam and is kept in contact by gravity or a light spring.

Ambassador

MODEL 6778AC

Four-Waveband Superheterodyne Tuning Down to 12 Metres



FEATURES. ***Waveranges.***—*(1) 12-35 metres. (2) 34-95 metres. (3) 200-550 metres. (4) 800-2,000 metres.* ***Circuit.***—*Pentode RF amplifier—triode hexode frequency changer—pentode IF amplifier—diode-triode second detector—pentode output valve. Full-wave valve rectifier.* ***Controls.***—*(1) Tuning. (2) Volume. (3) Waverange. (4) Tone and on-off switch.* ***Price.***—*(Console) 14 guineas. (Chassis, including valves and loud speaker) 10 guineas.* ***Makers.***—*Ambassador Radio Gramophones, Hutchinson Lane, Brighouse, Yorks.*

FROM the technical point of view, the chassis which has been developed by this Yorkshire firm has many features which indicated that the designers are not content to follow too slavishly the current conventions. As far as the RF amplifier, frequency-changer and IF stages are concerned the circuit is straightforward. It is worthy of note that the RF amplifier is tuned on all four wavebands, and it will be seen that AVC is applied to all three valves except on short waves, when the frequency changer is uncontrolled. Iron-cored IF transformers with Litz windings are employed and the final adjustment is made by moving the cores under the control of opposed springs. It is when we arrive at the second detector stage that the principal deviations from standard practice are to be found. A single diode is used for both signal and AVC rectification and the second diode of the DDT4 valve is tied down to earth. The impedance of the single diode was found to give just the right damping for the IF response required when the diode was connected across the whole of the output IF transformer secondary.

There is no delay on the AVC circuit and the designers are of opinion that the consequent elimination of threshold distortion more than outweighs the disadvantage of possible reduction of signal strength on weak stations near the level of background noise.

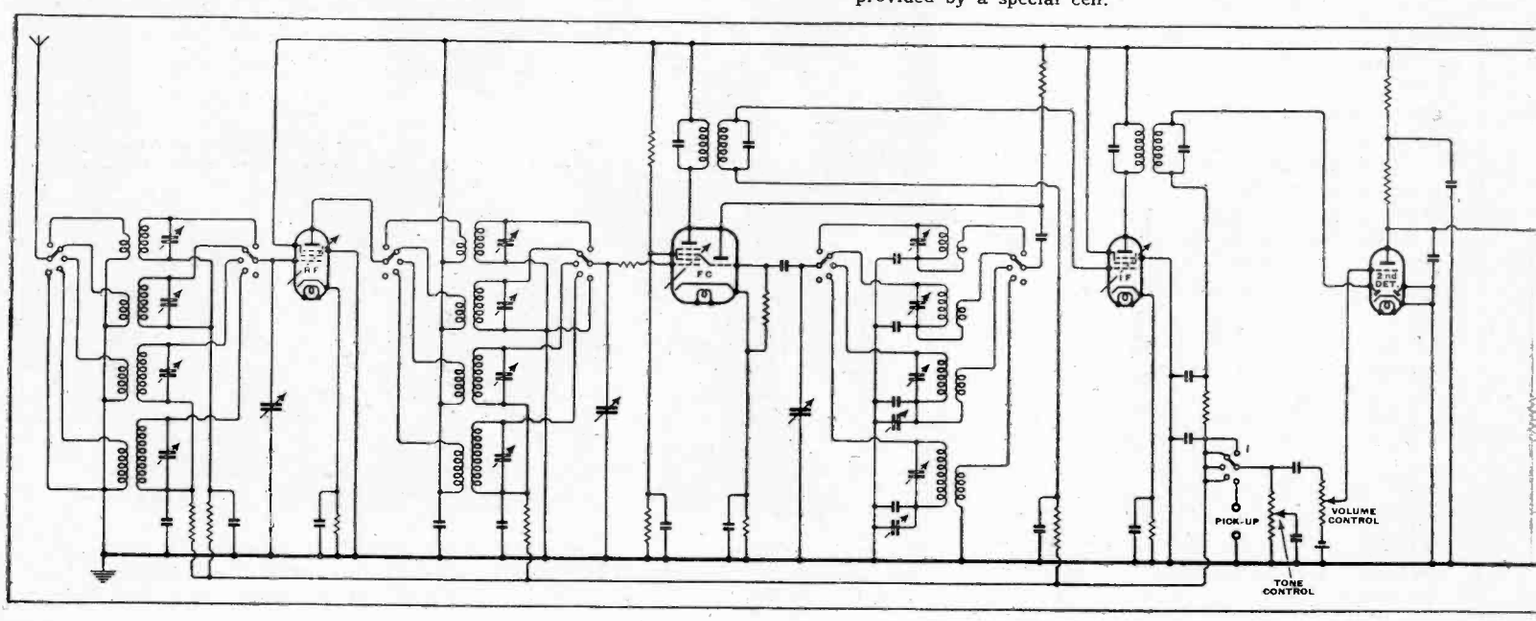
It is unusual to find battery bias in a mains receiver, but there can be no doubt of its advantages for the first AF amplifier in a receiver in which the HT line voltage is likely to be affected by the fluctuations in anode current of the large single output valve. The single cell used is of a special type and both mechanically and chemically is designed to last at least as long as the useful life of the receiver itself. The open circuit life is, in fact, not less than 40,000 hours.

Negative Feed Back

Tone control is effected by a shunt capacity on the diode load resistance and the matching conditions in the anode circuit of the output valve, therefore, remain reasonably constant. A measure of negative feed back is applied by making a part of the cathode bias resistance common to both grid and anode circuits.

A 10in. moving-coil loud speaker with an energised field-magnet of moderate dimensions has been developed for this receiver, and the cone is of graded thickness with a comparatively rigid centre. The balance of tone is in favour of the bass and

A single diode is used for signal and AVC rectification and the bias for the first AF amplifier is provided by a special cell.



treble which suits the volume level at which best quality of reproduction is obtained. With the overall magnification provided, the output stage can be overloaded when the volume is tuned to maximum on any station of programme value, and although the volume obtainable before distortion sets in is more than enough for normal domestic requirements, it does not quite carry the conviction of the 8 or 9 watts mentioned in the instruction leaflet.

There is plenty of unoccupied space in the console cabinet, and a fairly wide fillet surrounding the back serves to give more enclosure of air than usual. Any expectations of bass resonance were, however, doomed to disappointment, and the lower register was, in fact, quite free from boom. The plywood cabinet is reinforced at many points, and from the method of application it is evident that wood resonances have been carefully studied and adequately dealt with.

Sensitivity

The overall sensitivity is good, and the set is probably at its best on the two short-wave ranges. We were particularly impressed with the manner in which the sensitivity is maintained down to the bottom of the shortest waverange, and reception on the 13-metres broadcast band was much better relative to the 16- and 19-metre bands than usual.

American stations were well received, and second-channel repeat tuning points were absent, indicating good preselection. Microphony was only experienced on the strongest carriers and with the volume control turned deliberately and unnecessarily to maximum.

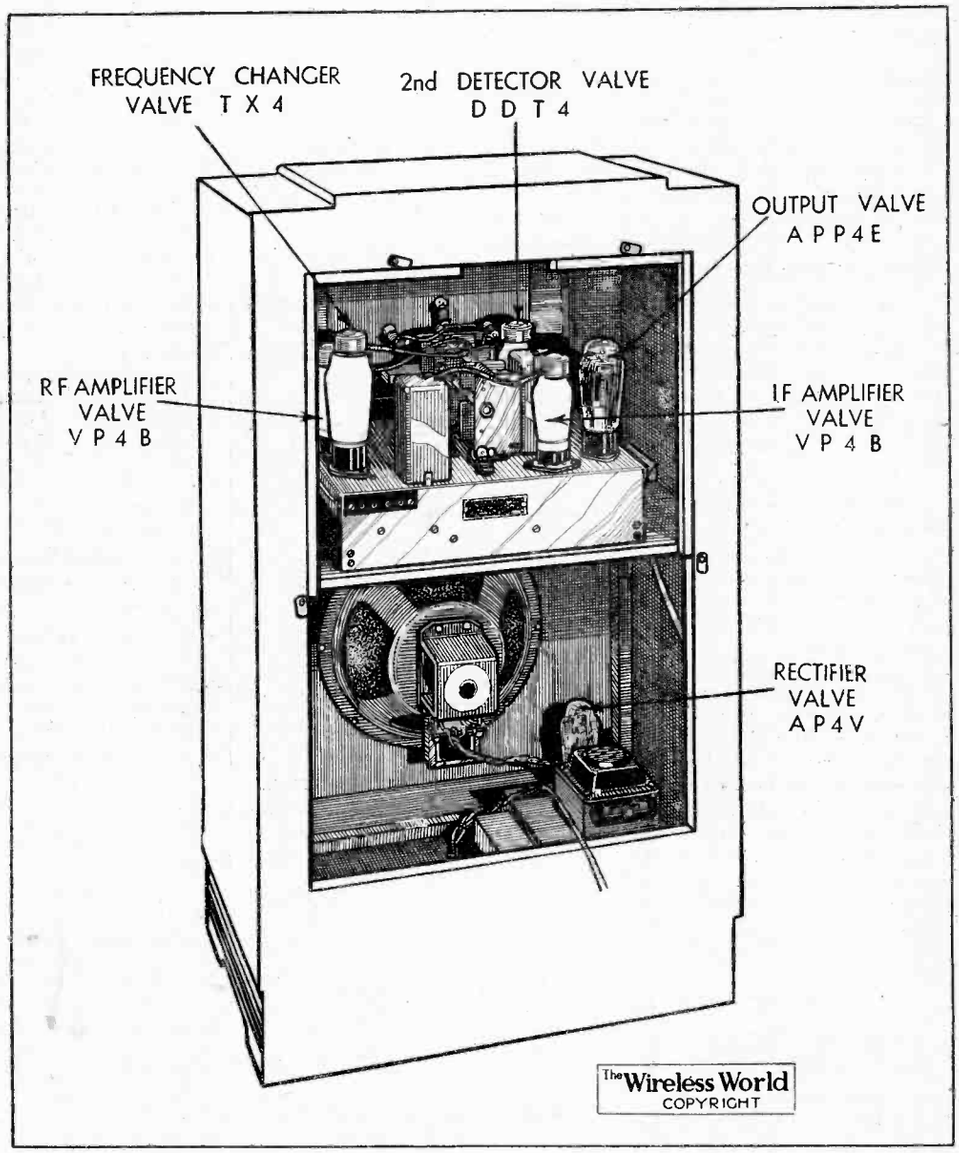
On medium waves, the reception of distant Regional stations was notable for the excellent programme value and good signal-to-noise ratio, but between stations background noise was prominent, due to the high sensitivity. From the character of the noise we infer that some degree of regeneration is permitted in the IF amplifier. Adjacent channel selectivity is possible on all stations with the exception of the locals, and the comparatively wide spread of four channels on either side of the London Regional station was attributable to some cause other than selectivity—possibly the effect of overloading in the frequency changer.

No second channel whistles were to be found on the medium-wave band, and on long waves the few which were present were located below the wavelengths at present used for broadcasting. The Deutschlandsender could be received comfortably clear of Droitwich and Radio-Paris with the tone control at minimum, and from its strength it could be inferred that the sensitivity on this range was well up to standard and only slightly less than that of the medium- and short-wave ranges.

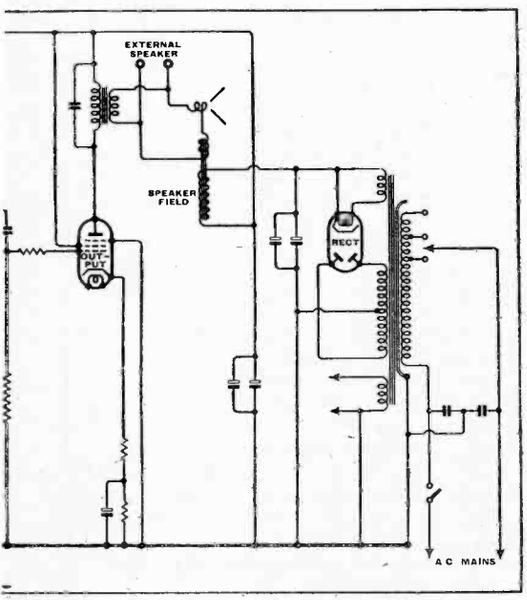
From the constructional point of view the receiver is sound, and there are several points which indicate that a moderate price has not been obtained at the expense of efficiency. All three sections of the gang condenser have widely spaced vanes, and the 9 : 1 reduction for the slow-motion tuning control which is integral with the condenser assembly is through a single pinion and gear wheel with opposed springing in the gearing to avoid backlash.

The semi-circular tuning dial is printed in three colours on a black background and is framed in a chromium-plated escutcheon. Station names are indicated on medium and long waves and are viewed through an aperture in the split pointer. In the console model the dial is nearly vertical and a fair distance back from the front glass, is not too well placed for comfortable tuning except from a low stool—that is, unless one is prepared to tilt the instrument as a whole, which is in fact quite practicable, as it is of comparatively light weight and the centre of gravity is low.

As well as the console there is a horizontal type table model at 12 guineas, and radiogramophones with and without record changers at 26 guineas and 20 guineas respectively.


FREQUENCY CHANGER VALVE T X 4
2nd DETECTOR VALVE D D T 4
OUTPUT VALVE A P P 4 E
R F AMPLIFIER VALVE V P 4 B
I F AMPLIFIER VALVE V P 4 B
RECTIFIER VALVE A P 4 V
The Wireless World COPYRIGHT

The power pack is mounted separately from the receiver chassis, and the 10-inch loud speaker has a special graded diaphragm. Extension loud speaker plugs are mounted on the output transformer.



CABLE CRISIS AT A.P.

Boat Race Television Triumph

FOR four hours before the start of the Boat Race Post Office engineers struggled to repair a line breakdown, which completely isolated Alexandra Palace from the telephone exchange, Broadcasting House and the mobile unit at Mortlake.

At noon on Saturday it was decided to pick up the National commentary on the Boat Race by radio, the receiver being a standard table-model superhet installed in Mr. Gerald Cock's office. This, incidentally, seemed to give a better "top" to the National quality than the line signal, which eventually came through just before the start of the race.

For some time before "zero hour" Philip Dorté, at Mortlake, sent messages to D. H. Munro, Productions Manager at Alexandra Palace, by means of hastily scribbled notes held in front of the television camera. Meanwhile, the Mortlake microphone being "dead," Howard Marshall was being rushed to Alexandra Palace to comment on the picture on the studio monitor.

The pictures from Mortlake were completely free from interference, due to the use of a new receiving point at Highgate, two miles from the transmitting station, the signals being sent by line to A.P.

RELAY OR RECORDS?

A Considered Opinion on Transatlantic Relays

RECORDS are cheaper than Transatlantic relays, and more satisfactory in practically every respect. This is the B.B.C.'s considered opinion after a series of experiments in relaying well-known dance bands direct from New York. It is realised that what thrill remains in hearing a band playing on the other side of the Atlantic is neutralised by uncertain reception conditions and the inevitable distortion.

On the other hand, recordings of American bands show off the performers at their best, and as the records can be broadcast immediately they are landed in this country, little time need be lost in keeping jazz fans *au fait* with latest developments on the other side. During the quarter from April to June the late-night record sessions on Mondays (National) are being devoted to discs made by crack American dance bands.

THE INDUSTRY IN GERMANY

Authorised Dealers Only

THERE has been a general reorganisation of the radio industry in Germany. The Ministry of Economics has issued regulations whereby only recognised dealers will be allowed to sell radio apparatus.

Examinations are to be arranged whereby it is hoped to substantially reduce the number of dealers from the present 30,000 and to raise the standard of efficiency.

Discounts in the trade have also been revised, and the granting of a discount other than that prescribed makes the manufacturer liable to prosecution. Discounts for dealers vary, according to the annual turnover, from 23 per cent. to 36 per cent., while wholesalers are allowed from 36 to 45 per cent.

RADIO-NATIONS

A New Schedule of English Broadcasts

LAST Sunday a new schedule came into operation at the League of Nations station at Prangins, near Nyon, on the north side of the Lake of Geneva. Each transmission will include an account of the latest activities of the League and the International Labour Office.

The complete schedule (in G.M.T.) of the English transmissions is as follows:—

1.	Sunday, 3.45-4.30 p.m.	HBH on 18,480 kc/s.	
2.	,, 6.45-7.30 p.m.	HBJ on 14.535	,,
		HBQ on 6,675	,,
3.	Monday, midnight-12.45 a.m.	HBO on 11,402 kc/s.	
4.	,, 7-7.15 a.m.	HBO on 11,402	,,
5.	,, 7.30-7.45 a.m.	HBJ on 14.535	,,

Transmission 1 should provide the best reception in India; 1 or 2 in South Africa, Egypt and the Near East; 2 (HBQ) in England and Northern Europe; 3 in North America, and 4 or 5 in Australia and New Zealand.

Reception reports will be welcomed by the Information Section, League of Nations, Geneva, Switzerland.

B.B.C. DEPARTMENTAL UNIFICATION

THE independence between B.B.C. departments has long been a point of wonder with the listening public, which has, in the course of years, attributed the peculiar internal organisation of the Corporation to conditions so complicated as to be beyond ordinary understanding.

This complimentary view of the situation is crushed with the news that departmental unification is to be established. The readjustment is said to have been made for practical and economic reasons, and it is expected that an influx of new names and new ideas from the Empire department will appear in home programmes.

NEWS OF

WHAT THE B.B.C. IS AND DOES

A Review of 1937

THE most notable events and developments in the fifteenth year of the British broadcasting service is presented in the B.B.C. Handbook, 1938, which is just published.

After a brief review of the year's work, the address of the King on the occasion of Their Majesties' Coronation and His message on Christmas Day are printed in full. The intricate arrangements for the Coronation broadcasts are well described, following which are chapters on television and the foreign news service.

Some interesting data are given in the miscellaneous information section, which occupies over seventy pages of the total 128.

An analysis of the distribution of wireless licences throughout the seven regions is very interesting. This shows that throughout Great Britain and Northern Island 68.3 families in every hundred hold wireless licences, a ratio which is only exceeded in the U.S.A. and Denmark. The regions with the highest ratio are the Midland and West, where there are as many as seventy-six licences per hundred families.

The hope is expressed in the foreword of this book, "that it will be of practical use to those many members of the great listening public who are interested in what the B.B.C. is and does and has yet to do."

GLASGOW EMPIRE EXHIBITION

Regular Broadcasts

A PERMANENT O.B. station is being established by the B.B.C. at the Empire Exhibition in Glasgow, and this will be in almost constant use from the opening date (May 3rd), when the King's inaugural speech is broadcast from Ibrox Stadium, until the Exhibition closes at the end of October. On the evening of the opening day listeners will be taken on a microphone tour of the Exhibition.

Prior to the opening of the exhibition a "documentary" programme will be broadcast giving an impression in sound of how this vast display has been built up, and recourse will be had to recordings being made by the B.B.C.'s mobile unit.

It is hoped to broadcast at least one programme daily from the Exhibition throughout its run. Many of the programmes will be dovetailed into special transmissions from the new Scottish Broadcasting House in Glasgow.

"ADVERTISING" AT THE MICROPHONE

THE ban on advertising at the B.B.C. microphone does not prevent the Corporation from broadcasting a feature programme concerned with the technique of advertising through the ages. Accordingly, National listeners are to hear "Banging the Big Drum" on April 29th.

This four-century survey of British publicity methods will go back to the time when the big drum was literally beaten outside bear pit and barn.

Will sponsored programmes be included in this survey?

"STUNT" BROADCASTING

THE return of "stunt" broadcasting in the B.B.C. programmes, such as the recent under-water commentary by John Snagge and the Transatlantic Spelling Bees, is a welcome indication that broadcasting is emerging from a long spell of lethargy. In the early days stunts were common, and did much to stimulate popular interest in the new medium of entertainment, but a humdrum period set in, marked by the unwillingness of the engineering branch to take risks or depart from the established routine.

Much could still be done to test the possibilities of ultra-short and micro-waves. In many outside broadcasts the commentators would have freer scope than at present if they could use micro-wave transmitters installed in knapsacks.

A broadcast of a parachute descent could be carried out without difficulty. Gliding would make an excellent subject for a summer afternoon broadcast, especially if a commentary could be given by micro-wave from a glider in flight.

The scope for technical experiments with a popular appeal is still enormous, and it is to be hoped that, with television looming ahead, the sound broadcasting officials will not adopt a defeatist attitude.

THE WEEK

SINGAPORE TO N. MALAYA VIA DAVENTRY

THE Empire Department at Broadcasting House has thrilled over reports received from Malayan amateurs who listened to the Daventry broadcasts of the opening of the Singapore Naval Base. Many of the listeners were tin miners and planters situated in out-of-the-way spots in Northern Malaya, only 100 miles or so from Singapore itself. Yet, because Malaya has no powerful broadcasting station of its own, they tuned in Daventry. The broadcast travelled from the Naval Base via fourteen miles of landline to the Singapore station, which transmitted it to Java, whence it was relayed to Holland, conveyed by submarine cable to Canterbury, relayed to London and so to Daventry, where it was finally re-broadcast to the Empire.

CAR RADIO

AN increase in the sales of car radio sets is forecast by radio manufacturers who are striving for the same percentage of radio motorists in England as is prevalent in America, where 17 or 18 per cent. of the cars on the road are fitted with wireless.

Investigations by Philips show that car radio is no longer confined to the large car, since 43 per cent. of the sets sold during the last six months were fitted into cars of the 10-12 h.p. class.

SPONSORED PROGRAMMES FROM ICELAND

THE Cairo agitation directed against European sponsored programmes in English has caused advertising agencies to seek fresh stations which they could turn to in the case of necessity.

Broadcast Advertising is reported to have approached the Icelandic programme director of Reykjavik with a view to radiating sponsored programmes from the new 100-kW station.

FROM ALL QUARTERS

Echoes from the Stratosphere?

THE Daventry announcer's voice, according to the *Sydney Bulletin*, has recently been accompanied by a series of strong echoes. The favourite evening wavelength in Australia appears to be 49.59 metres, used by GSA.

Taxing the Industry

A SUB-COMMITTEE of Congress in U.S.A. has proposed the repeal of 25,000,000 dollars' worth of excise taxes on various kinds of merchandise, but radio is not included. According to *Radio Retailing*, wireless manufacturers are making a strenuous effort to persuade the Government to repeal the 5 per cent. excise tax which is levied upon the industry.

Gift to Scientist's Widow

THE widow of Heinrich Hertz, who before his death in 1894 demonstrated the practicability of Clerk Maxwell's theory of wireless waves and laid the foundation for Marconi's experiments, was last week presented with a gift of £250 by Canon Marshall, of Cambridge, on behalf of the Pope, to whom one of Hertz's manuscripts was recently given.

Aberdeen Wireless Beacon

THE Northern Lighthouse Commissioners, after considering the question of the large number of fishing vessels wrecked near Aberdeen, have come to the conclusion that the solution of the problem might be met by the establishment of a wireless beacon at that port.

Cables to the West

BROADCASTING to the West Country will be improved with the completion of new cables which the General Post Office is now laying. The first section, which runs from Broadcasting House via Wigmore Street and Kensington Gardens, has just been finished.

Pocket Transmitter

VIENNESE police are experimenting with a small portable transmitter which is slung from the policeman's shoulder with the batteries in his coat pockets. This transmitter, which operates on a pre-determined wavelength and is for CW only, weighs just over $1\frac{3}{4}$ lb. complete with batteries.

Agony on the Air

ROAD accidents have assumed such alarming numbers in the U.S.A. that the authorities have resorted to gruesome descriptive broadcasts in an endeavour to frighten the public into caution.

School Broadcasting in Italy

ACCORDING to official figures there is a total of 2,627,262 children who are taught by school broadcasts in Italy, where more than 17,000 sets have been installed in schools.

Radio Service for Aircraft

AT the International Conference in Dublin on the Atlantic Air Service, it was decided to establish an elaborate organisation covering wireless communication, DF and meteorological reports.

TWO-WAY COMMUNICATION is being maintained during the Spanish war by the use of ultra-short-wave transmitter-receivers. As can be seen from this picture the complete apparatus is easily carried on the back of an infantryman.

New Radio-Paris

THE building of the Radio-Paris super-station at Mehun-sur-Yévre is progressing apace. The erection of the aerial mast is almost complete, and the hope is expressed that the station will be testing in June.

Free Sets in Egypt

THE Egyptian Sovereign ordered that 3,000 wireless sets should be distributed amongst the poor people of the Nile Valley. At the same time instructions were issued to the effect that educational broadcasts should figure in forthcoming programmes.

Music from Lithuania

RECENT frequency tests on the new telephone lines from Lithuania have revealed so great an improvement that it is now considered possible to use them for musical relays. Accordingly, the B.B.C. will take an Easter programme from Kaunas, the Lithuanian capital, on Easter Sunday.

Service

TWO German wireless experts flew from Berlin to the Antarctic in order to remedy a defect which had developed in the wireless installation on the *Walter Rau*, base ship of a large whaling fleet.

Cabarets from Abroad

A FRENCH cabaret and music-hall show will be relayed from Paris for British listeners on May 13th. Many of the artistes taking part are prevented by contracts or pressure of engagements from coming to England. Archie Campbell, of the B.B.C. Variety Department, will produce the programme in Paris. If the experiment is a success, it is hoped to visit each of the European capitals in turn.

Photographing Lightning

BEFORE a visible flash of lightning occurs an invisible discharge runs along its line of path. This preliminary disturbance is enough to affect a wireless set, and when amplified it can be made to actuate the shutter of a camera. In this way photographs of lightning which takes place in semi-daylight can be obtained.

Another Television Miracle

"A GREAT part of the Boat Race, which will be televised, may be rowed on the Alexandra Palace Lake, as I hear that the actual race cannot be followed by the camera, and only the finish will be the real thing."—*Bowes Park Weekly News.*

Turkish Broadcasts from Daventry?

THE *South Slav Herald*, Yugo-Slavia, reports that, according to the Arab Press in Palestine, the Daventry station will shortly broadcast in the Turkish language. The B.B.C. will be interested to learn that "the Turkish Government will itself probably arrange the programmes." This piece of news will be welcomed by the hard-worked producers at Broadcasting House, who will no doubt seek similar assistance from other Governments who can spare the time.

Stratosphere Investigations

IT is proposed, in the United States, to make regular meteorological observations by aircraft in the sub-stratosphere and pilotless balloons carrying automatic radio-meteorographs are to be employed with a view to investigating stratosphere conditions up to a height of 50,000 feet.

I.E.E. Summer Meeting

THE Council of the I.E.E. has accepted the invitation of the South Midland Centre to hold its summer meeting in the area from July 4th to 8th. The programme includes visits to the works of the G.E.C., B.T.-H., and the Austin Motor Company.

N.R.E.A. Election

AT the recently held annual general meeting of the National Radio Engineers' Association the following officers were elected: T. F. Nicholson, chairman; Reg. A. Loader, hon. secretary; and H. W. King, editor of the Association's journal, *Radioman*.

Miscellaneous Advertisements and Easter

WITH the approach of the Easter holidays slight alterations are necessary in our printing arrangements. Miscellaneous advertisements intended for the issue of April 21st must be received not later than first post on Thursday, April 14th.

Television Topics

LINE FLY-BACK TIME

AFTER the spot on the cathode-ray tube has traced out one scanning line it must fly back from the right-hand side of the picture to the left before it can start to trace out the next line. Although the fly-back is very rapid in comparison with the line traverse, it nevertheless occupies a finite time and gaps are accordingly included in the transmission of vision signals in which it must occur.

In Fig. 1 is shown a portion of the vision signal waveform at (a); starting at the beginning of a line we have the vision signal transmitted for 85 per cent. of the complete line period. This is represented in Fig. 1 by the waveform between the dotted lines A B. Then the synchronising pulse comes along and lasts for 10 per cent. of the line time; this is the part B C. Next there is an interval of 5 per cent. of the line time with a signal level corresponding to black, and this is shown by C D. The time represented by A D is that of one line with its fly-back. It is 1/10125 second for the present transmissions.

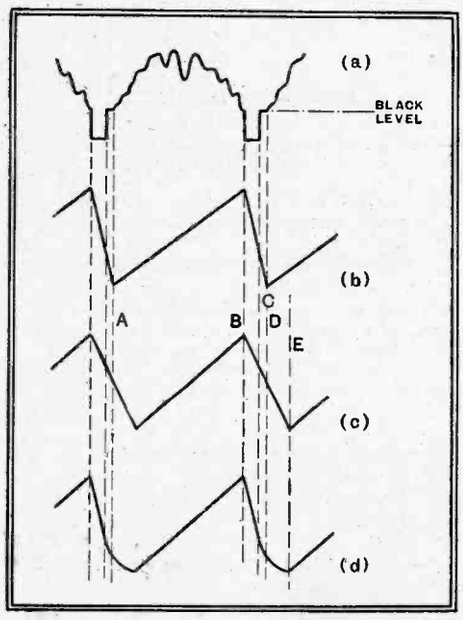


Fig. 1—The television signal waveform is shown at (a) and the correct shape of scanning waveform at (b). If the fly-back time exceeds that for the sync pulse and black edge (c) and (d) the left-hand side of the picture will be folded back.

For an undistorted picture it is necessary that the deflecting voltage should rise linearly during that portion of the time A D devoted to the picture modulation A B and fall back again to its original value during the time B D. The deflecting voltage (or current with magnetic deflection) should thus have the form of Fig. 1 (b).

It does not matter, however, if the fly-back is quicker than this. For instance, it might occur in 10 per cent. of the total time instead of 15 per cent.; if it does this, the remaining 5 per cent. of the time will appear on the left to right scanning stroke and give a black band on the left-hand edge of the picture. This is no disadvantage and the presence of such a band is proof that the fly-back time is quicker than is really necessary.

The effects of a slow fly-back time are more serious. The deflecting voltage might then have the form of Fig. 1 (c). The sync pulse and the following interval occur during the fly-back as usual, but it is easy to see that when the vision signal commences (D) the scanning spot is still flying back to the left instead of starting on the traverse to the right. The result is that the left-hand side of the picture appears to be folded back on itself, for the picture modulation appearing on the fly-back is very nearly superimposed on the picture modulation on the normal line when the spot at length starts to move to the right.

On many transmissions there is little detail in the extreme edges of the subject and the main effect is then a band of light on the left-hand side. The effect is disconcerting on panning shots, however, for then an object instead of moving out of the picture appears to move over the edge and then backwards!

A different effect is observed when the fly-back waveform is as shown at (d). Here the initial fly-back is very rapid, but there is an excessive interval after the fly-back before the commencement of the scanning stroke. The folding over of the picture does not then occur, but it appears as if the left-hand side were cut off and there is also a bright line down the extreme left of the picture.

With electrostatic deflection the time-base circuit is usually of the form shown in Fig. 2. The saw-tooth waveform is generated by the gas-triode V1 in conjunction with C1 and R1, the voltage appearing across C1. This is applied to V2 through an RC coupling in the usual way and if C2 and R2 are large enough they have little effect. The input capacity of V2 has no harmful effect for it is in shunt with C1 and merely increases its capacity somewhat.

The output of V2 is developed across the coupling resistance and one deflector plate is fed from the anode. A portion of the output voltage is tapped off at the junction of R5 and R6 and fed to V3. This valve produces an output across R7 which is fed to the other deflector plate. The conditions are such that the outputs at the anodes of V2 and V3 are equal and of opposite phase. Assuming R3 is very large compared with R6 this is achieved when $1+R5/R6$ equals the gain of V3 and $R7=R5+R6$.

The Time-constants

At line frequency the stray capacities have an important effect. In the anode circuit of V2 the capacity represented by C4 includes the anode-cathode capacity of V2, the CR tube capacity and wiring capacities, and in the anode circuit of V3, C5 represents a similar capacity. The absolute value of these capacities is naturally unimportant. What is important is their value relative to the circuit resistances and the effective resistance is the coupling and valve resistance in parallel.

In the input circuit of V3 the capacity is C6 and includes the Miller effect in this

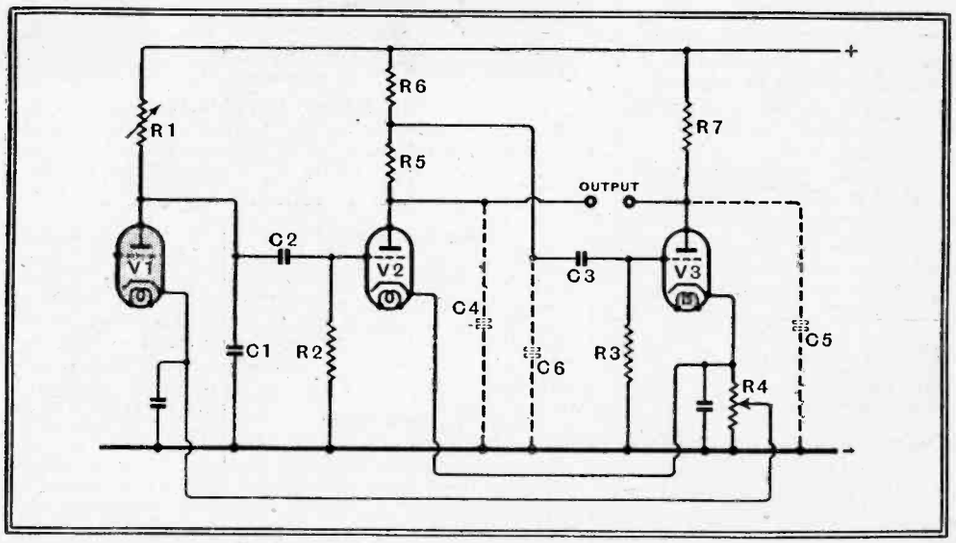


Fig. 2.—The circuit of a typical time-base for electrostatic deflection is shown here. The fly-back time depends largely upon the stray capacities C4, C5 and C6.

Television Topics—

valve; its effective value may easily be 60 $\mu\mu$F. or more. Fortunately the associated resistance is comparatively low, being R6 in parallel with the series combination of R5 and the AC resistance of V2.

The fly-back time is largely governed by the time constants in these circuits, the time-constant being the product of the effective capacity and resistance. The resistance component is usually composed chiefly of the valve resistance, because it is lower than the coupling resistance, being often only one-tenth the value of the latter. Now the valve resistance is not a constant but varies with the anode voltage, increasing as the voltage falls. Because of this we always use a high load resistance in a triode voltage amplifier, for the variations in AC resistance are then small compared with the load resistance and little distortion occurs.

From the point of view of the time-constant, however, the valve resistance and load resistance must be considered as in parallel, and variations in valve resistance have an appreciable effect. When the valves are being driven hard, as they usually are in a time-base, the variations are important.

At the start of the fly-back the grid voltage of V2 is at its most positive point and the anode voltage is consequently at its most negative. The anode voltage of V3 is at its most positive potential. At the instant of fly-back, therefore, the AC resistance of V2 is at its highest and that of V3 is at its lowest. Stray capacities are consequently more important in the output circuit of V2 than in the case of V3, and to obtain a rapid fly-back it is important to reduce them to the lowest possible figure.

Television Reception Technique. By Paul D. Tyers. Pp. 144+x. Published by Sir Isaac Pitman and Sons, Ltd., Pitman House, Parker Street, Kingsway, London, W.C.2. Price 12s. 6d.

IN the first chapter of this book the basic principles of television are very briefly described, and in the second the resonant aerial and its feeder are discussed. The main section of the book is then begun with a chapter on amplification, RF, IF and VF. Chapters on cathode-ray tube practice, time-base and synchronising circuits follow, and then the vision receiver as a whole is dealt with. The book concludes with a chapter on vision receiver faults and an appendix.

In his preface the author addresses himself primarily to those who may become engaged in the design of a television receiver, and it is, consequently, upon its value to such engineers that the book must be judged. Although a fairly wide ground is covered, the book is to a large extent merely descriptive in character and the details are very sketchy. In very few instances are values of components mentioned; while this may be a legitimate omission in a book intended for designers, it detracts from its value when coupled with an absence of any intimation as to how they may be calculated. It is true that it is always possible to derive the necessary equations for oneself from basic circuit theory, but this is a lengthy business and few people can spare the time.

Several inaccurate statements occur. On page 31, in referring to IF intervalve couplings with coupled pairs of tuned circuits, it is stated that "the presence of a short grid lead or even a fairly long one is a matter of little consequence. The lead need not even be of low capacitance or have low losses, because it is simply in shunt with a resonant circuit having high losses." Actually, of course, shunt capacity is very important indeed, and for a given band-width and valve mutual conductance the stage gain is limited only by capacity, the gain being inversely proportional to capacity. The importance of low capacity in the tuned circuits generally does not seem to be appreciated by the author.

In dealing with the question of feeding the CR tube directly from the detector, the only disadvantages of this course are given as the extra high IF gain needed as compared with the case when a VF stage is used. Actually, the greatest difficulty lies in obtaining sufficient output from the last IF valve. He goes on to say that with a VF stage it is necessary to use a direct connection between the detector and VF valve and between this valve and the tube in order to preserve the DC component. In the circuits shown, however, there is some discriminatory action against the DC component, in spite of the direct connection. The important question of DC restoration is barely mentioned.

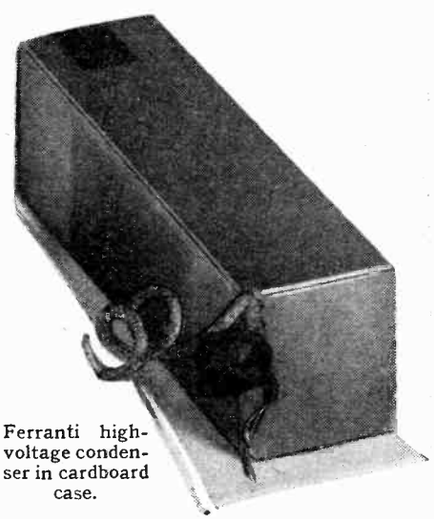
Some excellent photographs of defective television images are included and some indication is given of the nature of the defects, but very little as to the proper remedies to apply.

W. T. C.

FERRANTI ELECTROLYTIC CONDENSERS

ELECTROLYTIC condensers are not common for higher voltage ratings than 500 volts or so, but Ferranti, Ltd., of Moston, Manchester, 10, have introduced a type rated for 650 volts working and capable of withstanding surges of 720 volts.

The condensers are available in 8-mfd. blocks in the cardboard-case type or in square or cylindrical cans. Special models can be supplied for tropical use, and in these no metal but aluminium is used inside the cases. The overall dimensions of the cardboard-case type are $4\frac{7}{16}$in. × $1\frac{1}{4}$in. × $1\frac{9}{16}$in.

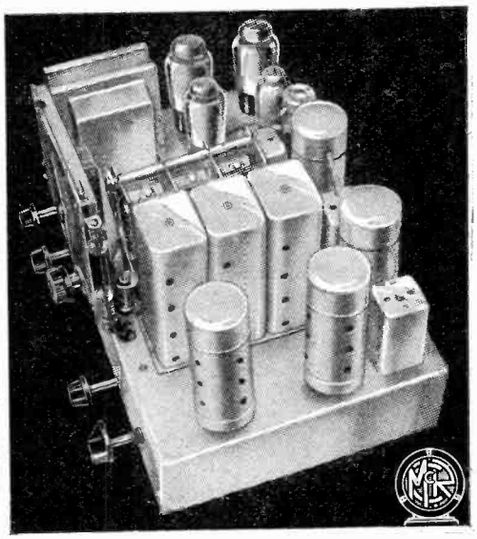


Ferranti high-voltage condenser in cardboard case.

With their high voltage rating the condensers are suitable for use as reservoir condensers in HT supply systems with transformer windings up to 450 volts RMS.

McCARTHY

The Chassis Specialists



"ONE of the direct results of unbridled competition between set manufacturers, which has developed into a race to produce the cheapest sets rather than the best, has been an increasing tendency to take unwarranted risks in the matter of the choice of components."—"Wireless World," March 24.
It is precisely for this reason that it is not possible to offer McCarthy Chassis at a price comparable with the cheapest; but it is possible for McCarthy engineers to specify materials and components of fine quality, affording an adequate margin of safety.
As an example of these sound principles in design and construction, we offer the McCarthy

9-VALVE 4-WAVE SUPERHETERODYNE

priced at 14 guineas including valves

The Circuit in Brief.—The pre-selector circuit is coupled to high-gain radio frequency amplifier operating on all 4 wave-bands, which is transformer-coupled to latest type triode-hexode frequency-changer. There are 2 band-pass transformer-coupled I.F. amplifiers (intermediate frequency 465 K.C.'s). The double diode second detector provides automatic volume control applied to 4 preceding valves, and first stage L.F. amplification. The triode phase-changer is capacity-coupled to push-pull output pentodes (or Harries-tetrodes) delivering 9 watts.

Principal Features.—Waveband coverage—12.8-33, 29-80, 190-550, 800-2,000 metres. Controls—sensitivity control (varying bias on R/F stage): 5-position wave-change and gramophone switch: combined volume control and on/off switch and progressive variable tone control (both operative on radio and gramophone).

The McCarthy Portable. 6 gns. Unusually fine performance obtained from special reflex circuit. Weight only 16½lbs. Compact. Exceptionally low consumption. Attractive finish and choice of three colours.

EASY TERMS ON APPLICATION

Send 3d. in stamps for complete illustrated catalogue with technical data and circuit diagrams of other interesting McCarthy chassis of all types, for A.C., Battery, or A.C./D.C. Abridged list free of charge.

McCARTHY RADIO LTD

44, Westbourne Grove, London, W.2

Telephone: Bayswater 3201/2.

Random Radiations

By "DIALLIST"

Sunday Television

THIS week the B.B.C. inaugurated its Sunday television programmes from the Alexandra Palace, and these should help to give television another big push in the right direction. With an outside broadcast in the afternoon and a play in the evening, owners of television sets had splendid fare on the first Sunday, and it is expected that, during the lighter part of the year at any rate, some such arrangement is likely to be continued. Another excellent innovation is the transmission of a news bulletin on the ultra-short waves after the week-day evening programme. As the evening transmission begins at 9 o'clock, those who were looking in previously missed the National bulletin. It is the recording of this that is now sent out for the benefit of viewers.

In the Right Direction

That 41.5-megacycle news bulletin I welcome, too, for another reason: it gives those who have wireless receivers that tune down to the neighbourhood of 7 metres real encouragement to use their sets for local ultra-short-wave reception. It is true that they can't yet sample to the full the quality of reproduction that is obtainable on the ultra-short waves except on Sundays, for on other days this news bulletin is a recording. I hope, though, the bulletin may be the thin end of a wedge that many of us would like to see driven home. *The Wireless World* has long urged that the whole of one or other of the London programmes should be radiated on the ultra-short waves, and it is understood that the B.B.C.'s preparations for doing so are complete to the last turn of wire. If only the opposition to them were removed a wonderful field would be opened for the development of the genuine high-fidelity receiving set for local use only. You have only to hear the "sound" portion of the present television programmes reproduced by such an instrument to realise what an appeal there would be to those who want the very best in radio reproduction and are prepared to pay for it.

Surprising Italian Figures

I WAS astonished to hear the other night in the news bulletin that the official figure for licensed listeners in the whole of Italy was only 840,000. This means that though Italy's population is only one-and-a-quarter millions less than ours her licensed listeners number less than one-tenth of those in the United Kingdom. With us, approximately one in five of the entire population holds a receiving licence; for Italy the figure is one in fifty-one. Yet the Italian broadcasting service is a particularly good one. Not reckoning short-wave transmitters, the country possesses 18 stations, of which ten are rated at 10 kilowatts or more, and only one at less than 1 kilowatt. Italy has thus one more station than Britain, though there is considerable difference in the total output rating. Taken together, the ratings of British stations work out at 867.3 kilowatts, whilst the Italian figure is 363.2. On a kilowatt basis Italy should have rather more than two-fifths of our number of licensed listeners, or, say, 3,500,000. As it is, the total output from B.B.C. stations represents roughly one-tenth of a watt per licence, and that of the Italian stations more than four-tenths.

Housing the Television Receiver

TELEVISION has introduced new problems to the designer, apart from those of an electrical nature. When the apparatus is not in use, the blank end of the CR tube is apt to spoil the appearance of the cabinet, looking at it as a piece of furniture. To overcome this it has been proposed that the tube and speaker be masked by a grille or fret which is arranged to fold so as to expose the end of the tube only when the apparatus is in use.

As the equipment is generally used in a darkened room, some illumination of the controls is often desirable. The suggestion has been made that the control panel should therefore be made of transparent moulded material and illuminated from the edge. The use of a plastic material has the great advantage of simplicity in manufacture.

The Simple Little Set

YOU, I expect, are like me in having friends who appoint you their mentor and guide in matters wireless. If so, you are familiar with those who desire "only the simplest little set." They want, they declare, something quite small; it needn't bring in more than just two or three foreign stations, and really they could manage quite well if it brought in none at all. But as they are musically inclined and like to hear the big concerts perfectly reproduced, what they do insist upon is high quality from the loud speaker. They conclude by saying that since they don't want lots of foreign stations quite a cheap little set will obviously do all that they want, so what can you recommend at about five pounds? Observing, perhaps, a slightly pained expression on your countenance, they hasten to add that, of course, if it was really necessary they wouldn't mind going to six pounds, or perhaps even to seven. They then stress the point that it is only a *little* set that they want—a portable, in fact, might do quite well.

Hard to Convince

Whenever that sort of enquiry comes my way I am reminded of a jest that appeared in *Punch* many years ago. The illustration showed a perfectly brainless youngster in converse with a hard-boiled old horse coper. Every horse in the stables has been trotted out for inspection and found not quite the thing. "I thinks I knows exactly what you wants, sir," says the dealer. "Well-bred 'oss up to a good deal of weight, sound as a bell and with perfect mouth and manners. Good shoulders, the right sort of 'ocks, well ribbed up, short in the back and deep in the chest. Jump hanything. Price about twenty pound. I can tell you just where to find 'im." "Where?" "In 'Eaven." It's awfully hard to explain to the uninitiated that such a simple little set at such a simple little price is not to be found on this earth of ours. It takes you all your time to convince them that it doesn't cost much to produce a sensitive set that will bring in heaps of foreign stations, though it costs a lot to make a receiver that will please a musician's ear when dealing with a transmission from the Queen's Hall. Short of actual demonstration, it is often still harder to make them believe that for anything like fidelity you must have a big set housed in a large cabinet.

The Only Way

At this point your seeker after good counsel may confound you by saying that he (or more probably she) has heard in somebody else's house a midget, almost given away by its vendors, whose reproduction was as near perfect as makes no matter. You then realise that the enquirer has never heard—and what proportion of those who listen to wireless programmes have heard?—a first-rate receiving set at work. Their wireless education is, in fact, little more advanced, so far as the ear is concerned, than yours was the best part of ten years ago. If your own set happens to be in working order at the time (though that belonging to the real enthusiast is generally out of action for alterations just at such moments) you can stage a demonstration that will be a real revelation by inviting both your suppliant and the owner of the midget set to spend the following evening, the latter being asked to bring his little marvel with him. By installing a simple aerial and earth-switching system, so that you can work one set against the other, you will soon convince all concerned that there is something not obtainable for a five-pound note or with a tiny receiver in this quality business. The alternative is to take the believer in five-pound high-quality reproduction to some big wireless shop, where the respective merits of the simple little set and the highly complicated big set can be demonstrated.

Foreign Broadcasts

RECENTLY I mentioned that our Arabic broadcasts were not going down too well with listeners in some parts of the Near East, Palestine in particular. Further information from people on the spot adds confirmation. There appear to be two chief troubles. One is, as I suggested, that they don't like the European music that we give them for their entertainment; the other that the Arabic spoken by the B.B.C. announcers and talkers is too highbrow to be readily understandable by many of the Arab inhabitants of Palestine. Readers may remember that when this business of short-wave broadcasting in foreign languages was first mooted I ventured to doubt whether it would be a success if undertaken direct from this country owing to the difficulties set up by the existence of so many languages and dialects. I suggested then that it might be better, so far as the Empire and mandated countries were concerned, to make greater use of local broadcasting services. And that I still think is the best possible solution of the problem. Palestine, for example, has a pretty good broadcasting service of its own, and the 20-kilowatt Jerusalem station must be well heard not

only in its own country but also over a considerable part of the world where Arabic is spoken. Is it not worth while at any rate to try the experiment of subsidising first-rate programmes for Arabs from that station, providing at the same time material for the news bulletins and leaving it to the local speakers to use the kind of Arabic that is most readily understood by their hearers?

Many Happy Returns

READERS, I'm sure, were delighted to hear the "Roosters" again when they gave their twenty-first birthday party the other evening. Theirs is a record to be proud of, as you must have realised if you heard that show. The "Roosters" were born as a concert party at Salonika in 1917, and took their name from Captain Roose, who was commanding the company to which they belonged. They did noble work at Salonika in cheering up troops dispirited by a long period of doing absolutely nothing. From Salonika they went to Palestine, where they were officially appointed as Divisional Concert Party. And a pretty hard time they must have had of it, trekking miles every day by lorry from unit to unit. Before the Armistice they were at Alexandria, and they continued the good work there until they were "demobbed" in 1919. Their first broadcast was in 1923—I remember it well—and since then they have provided some of the most welcome of radio's variety. It was good to hear when the roll was called that only one of the original Roosters had fallen by the way. Long may the rest live and often may they entertain us!

Three-Valve Straight Set

IT is regretted that an error occurred in the practical wiring diagram of this receiver; the diagram appeared on page 284 of *The Wireless World* for March 31st, 1938. In the drawing pin No. 1 of the valveholder for the APP4E valve was shown unconnected; actually, of course, it should be joined to cathode, Pin No. 6.

NEW COSSOR BATTERY VALVE

A VALVE of most unusual type has been introduced by A. C. Cossor, Ltd., of Cossor House, Highbury Grove, London, N.5. It is an indirectly heated pentode for battery operation!

Detector valve for portable sets.

The heater takes 0.2 ampere at 2 volts, and the valve is fitted with an indirectly heated cathode in order to reduce microphony. It is intended primarily for use as a detector in portable receivers, in which trouble is sometimes experienced from microphony when filament-type valves are used.

The valve is the Type 220 IPT, and is rated for 150 volts and 80 volts for anode and screen respectively. As a detector resistance coupling should be used with a 0.1 MΩ coupling resistance, while the screen should be fed from positive HT through a 1 MΩ resistance and decoupled with a 1 mfd. condenser. The mutual conductance is 1 mA/v at 150 volts, 60 volts, and 0 volts for anode, screen and grid. The valve is fitted with a 7-pin base and the anode is the top connection.

Although similar to an RF pentode, the valve is not recommended as an RF amplifier, for its grid-anode capacity is too high for the maintenance of stability. The valve is designed to operate as a detector.

Television Programmes

THURSDAY, APRIL 7th.

3, Powder and Pipe-clay—a revue of old Army songs. **3.30,** British Movietonews. **3.40,** 135th Edition of Picture Page.

9, 136th Edition of Picture Page. **9.30,** O.B. from the Harringay Arena of the Light-Heavyweight Championship of Great Britain—McAvoy v. Harvey. **10,** News Bulletin.

FRIDAY, APRIL 8th.

3, Marcel Boulestin gives a cooking demonstration. **3.15,** Gaumont-British News. **3.25-4.25,** "Will Shakespeare"—a special version of Clemence Dane's great biographical play, with Henry Oscar in the name part.

9, Repetition of 3 p.m. programme. **9.15,** British Movietonews. **9.25,** "The Seventh Man"—a play by Michael Redgrave, based on the story by "Q." **9.55,** Preview. **10.5,** News Bulletin.

SATURDAY, APRIL 9th.

2.50, O.B. from the Wembley Stadium of the International Association Football Match—England v. Scotland. **4.40-4.50,** Gardening talk by R. Findlay—Spring Flowers.

9, "Going Places"—a trivial travelogue. **9.20,** Gaumont-British News. **9.30,** "Wren of St. Paul's" written for television by Christine Hahlo. **10.10,** "Clock Summer in with Horrabin"—a summertime feature. **10.20,** News Bulletin.

SUNDAY, APRIL 10th.

8.50, News Bulletin. **9.5,** "The Blue Madonna" danced by Wendy Toye to the music of the Air on the G String (Bach). **9.10,** Clothes Line. **9.25,** Gaumont-British News. **9.35-10.15,** "Wien," a Viennese entertainment, including Lisa Minghetti, Irène Prador and Marcella Salzer.

MONDAY, APRIL 11th.

3, "Going Places," repetition of Saturday's 9 p.m. programme. **3.25,** Gaumont-British News. **3.35,** "The Seventh Man," repetition of Friday's 9.25 p.m. programme.

9, Starlight. **9.10,** British Movietonews. **9.20,** Cabaret Cruise, compèred by Commander A. B. Campbell. **10,** News Bulletin.

TUESDAY, APRIL 12th.

3, Fashions for Cruising. **3.15,** British Movietonews. **3.25,** Cabaret Cruise, repetition of Monday's 9.20 p.m. programme.

9, Spring Fashions. **9.15,** Gaumont-British News. **9.25,** "The Gay Lord Quex"—a play by Arthur Pinero. **10.20,** News Bulletin.

WEDNESDAY, APRIL 13th.

3, "The End of the Beginning," a comedy in one act by Sean O'Casey. **3.25,** Gaumont-British News. **3.35-4.35,** "Everyman"—a masque by Pepler.

9, Ambrose and his Orchestra, with Evelyn Dall, the Three Admirals, and Max Bacon. **9.30,** British Movietonews. **9.40,** "The Maker of Dreams," a Fantasy by Oliphent Down—cast includes Dinah Sheridan and Quinton McPherson.

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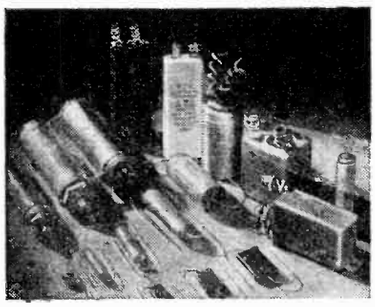

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PRINCIPAL BROADCASTING STATIONS OF EUROPE

Arranged in Order of Frequency and Wavelength

(Stations with an Aerial Power of 50 kW. and above in heavy type)

Station.	kc/s.	Tuning Positions.	Metres.	kW.
Ankara (Turkey)	152		1973.5	5
Kaunas (Lithuania)	153		1961	7
Radio Romania (Brasov) Romania	160		1875	150
Hilversum, No. 1 (Holland) (10 *kW.* till 1640)	160		1875	150
Lahti (Finland)	166		1807	150
Moscow, No. 1 (Komintern) (U.S.S.R.)	172		1744	500
Paris (Radio Paris) (France)	182		1648	80
Istanbul (Turkey)	185		1622	5
Irkutsk (U.S.S.R.)	187.5		1600	20
Deutschlandsender (Germany)	191		1571	60
National (Droitwich)	200		1500	140
Minsk (U.S.S.R.)	208		1442	35
Reykjavik (Iceland)	208		1442	16
Motala (Sweden)	216		1389	150
Novosibirsk (U.S.S.R.)	217.5		1379	100
Warsaw, No. 1 (Poland)	224		1339	120
Luxembourg	232		1293	150
Moscow, No. 2 (U.S.S.R.)	232		1293	100
Kalundborg (Denmark)	240		1250	60
Vienna, No. 2 (Austria)	240		1250	0.5
Kiev, No. 1 (U.S.S.R.)	248		1209.6	100
Tashkent (U.S.S.R.)	256.4		1170	25
Oslo (Norway)	260		1153.8	60
Vigra (Aalesund) (Norway)	260		1153.8	10
Leningrad, No. 1 (U.S.S.R.)	271		1107	100
Tromsö (Norway)	282		1065	10
Tiflis (U.S.S.R.)	283		1060	35
Moscow, No. 3 (U.S.S.R.)	300		1000	100
Saratov (U.S.S.R.)	340		882.3	20
Finmark (Norway)	347		864	10
Archangel (U.S.S.R.)	350		857.1	10
Rostov-on-Don (U.S.S.R.)	355		845.1	20
Budapest, No. 2 (Hungary)	359.5		834.5	18
Sverdlovsk (U.S.S.R.)	375		800	40
Voroneje (U.S.S.R.)	390		769	10
Boden (Sweden)	392		765	0.6
Banska-Bystrica (Czechoslovakia) (15 *kW.* after 1700)	392		765	30
Geneva (Switzerland)	401		748	1.3
Ostersund (Sweden)	413.5		726	0.6
Oulu (Finland)	431		696	10
Tartu (Estonia)	512		586	0.5
Hamar (Norway)	519		578	0.7
Innsbruck (Austria)	519		578	1
Ljubljana (Yugoslavia)	527		569.3	6.3
Viipuri (Finland)	527		569.3	10
Bolzano (Italy)	536		559.7	10
Wilno (Poland)	536		559.7	50
Budapest, No. 1 (Hungary)	546		549.5	120
Beromünster (Switzerland)	556		539.6	100
Radio Eireann (Athlone) (Ireland)	565		531	100
Klaipeda (Lithuania)	565		531	15
Palermo (Italy)	565		531	3
Stuttgart (Germany)	574		522.6	100
Alpes-Grenoble, P.T.T. (France)	583		514.6	20
Madona (Latvia)	583		514.6	50
Vienna, No. 1 (Austria)	592		506.8	100
Athens (Greece)	601		499.2	15
Rabat (Morocco)	601		499.2	25
Sundsvall (Sweden)	601		499.2	10
Florence, No. 1 (Italy)	610		491.8	20
Brussels, No. 1 (Belgium)	620		483.9	15
Cairo, No. 1 (Egypt)	620		483.9	20
Christiansand (Norway)	629		476.9	20
Lisbon (Portugal)	629		476.9	15
Tröndelag (Norway)	629		476.9	20
Prague, No. 1 (Czechoslovakia)	638		470.2	120
Lyons, P.T.T. (France)	648		463	100
Petrozavodsk (U.S.S.R.)	648		463	10
Cologne (Germany)	658		455.9	100
Jerusalem (Palestine)	668		449.1	20
North Regional (Slaithwaite)	668		449.1	70
Sottens (Switzerland)	677		443.1	100
Belgrade (Yugoslavia)	686		437.3	20
Paris, P.T.T. (France)	695		431.7	120
Stockholm (Sweden)	704		426.1	55
Rome, No. 1 (Italy)	713		420.8	100
Hilversum, No. 3 (Holland)	722		415.4	17
Kharkov, No. 1 (U.S.S.R.)	722		415.4	10
Fredrikstad (Norway)	722		415.4	1
Madrid, EAJ2 (Spain)	731		410.4	3
Seville (Spain)	731		410.4	5.5
Tallinn (Estonia)	731		410.4	20
Munich (Germany)	740		405.4	100
Marseilles, P.T.T. (France)	749		400.5	100
Pori (Finland)	749		400.5	1
Katowice (Poland)	758		395.8	12
Scottish Regional (Burghead)	767		391.1	60
Scottish Regional (Westerglen)	767		391.1	70
Stalino (U.S.S.R.)	776		386.6	10
Toulouse, P.T.T. (France)	776		386.6	120
Leipzig (Germany)	785		382.2	120
Barcelona, EAJ1 (Spain)	795		377.4	7.5
Lwow (Poland)	795		377.4	50
Welsh Regional (Penmon) (Anglesey)	804		373.1	5
Welsh Regional (Washford)	804		373.1	70
Milan, No. 1 (Italy)	814		368.6	50
Bucharest (Romania)	823		364.5	12
Agen (France)	832		360.6	1.5
Kiev, No. 2 (U.S.S.R.)	832		360.6	40
Berlin (Germany)	841		356.7	100
Sofia (Bulgaria)	850		352.9	100
Norwegian Relay Stations	850		352.9	—
Valencia (Spain)	850		352.9	3
Simferopol (U.S.S.R.)	859		349.2	10
Strasbourg (France)	859		349.2	100
Poznan (Poland)	868		345.6	16
London Regional (Brookmans Park)	877		342.1	70
Linz (Austria)	886		338.6	15
Graz (Austria)	886		338.6	15
Helsinki (Finland)	895		335.2	10
Limoges, P.T.T. (France)	895		335.2	1.5
Hamburg (Germany)	904		331.9	100
Dniepropetrovsk (U.S.S.R.)	913		328.6	10
Toulouse (Radio Toulouse) (France)	913		328.6	60
Brno (Czechoslovakia)	922		325.4	32
Brussels, No. 2 (Belgium)	932		321.9	15
Algiers (Algeria)	941		318.8	12
Göteborg (Sweden)	941		318.8	10
Breslau (Germany)	950		315.8	100
Paris (Poste Parisien) (France)	959		312.8	60
Bordeaux-Sud-Ouest (France)	968		309.9	30
Odessa (U.S.S.R.)	968		309.9	10
Northern Ireland Regional (Lisnagarvey)	977		307.1	100
Bologna (Radio Marconi) (Italy)	986		304.3	50
Torun (Poland)	986		304.3	24
Hilversum No. 2 (Holland) (15 *kW.* till 1810)	995		301.5	60
Bratislava (Czechoslovakia)	1004		298.8	13.5
Chernigov (U.S.S.R.)	1013		296.2	4
Midland Regional (Droitwich)	1013		296.2	70
Barcelona, EAJ15 (Spain)	1022		293.5	3
Cracow (Poland)	1022		293.5	2
Oviedo (Spain)	1022		293.5	0.7
Königsberg, No. 1 (Heilsberg) (Germany)	1031		291	100
Parede (Portugal)	1031		291	5
Leningrad, No. 2, RW70 (U.S.S.R.)	1040		288.5	10
Rennes-Bretagne (France)	1040		288.5	120
West of England Regional (Washford)	1050		285.7	50
Bari No. 1 (Italy)	1059		283.3	20
Paris (Radio Cité) (France)	1068		280.9	2
Tiraspol, RW57 (U.S.S.R.)	1068		280.9	10
Bordeaux-Lafayette (France)	1077		278.6	35
Falun (Sweden)	1086		276.2	2
Zagreb (Yugoslavia)	1086		276.2	0.7
Madrid, EAJ7 (Spain)	1095		274	5
Vinnitsa (U.S.S.R.)	1095		274	10
Kuldiga (Latvia)	1104		271.7	10
Naples No. 1 (Italy)	1104		271.7	10
Moravska-Ostrava (Czechoslovakia)	1113		269.5	11.2
Alexandria, No. 1 (Egypt)	1122		267.4	0.5
North-East Regional (Stagshaw)	1122		267.4	60
Nyiregyhaza (Hungary)	1122		267.4	6.25
Hörby (Sweden)	1131		265.3	100
Turin, No. 1 (Italy)	1140		263.2	7
Genoa, No. 1 (Italy)	1140		263.2	10
Trieste (Italy)	1140		263.2	10
London National (Brookmans Park)	1149		261.1	20
North National (Slaithwaite)	1149		261.1	20
Scottish National (Westerglen)	1149		261.1	50
Kosice (Czechoslovakia)	1158		259.1	10
Monte Ceneri (Switzerland)	1167		257.1	15
Copenhagen (Denmark)	1176		255.1	10
Nice-Côte d'Azur (France)	1185		253.2	60
Frankfurt (*and Relays*) (Germany)	1195		251	25
Prague, No. 2 (Czechoslovakia)	1204		249.2	5
Lille, P.T.T. (France)	1213		247.3	60
Rome, No. 2 (Italy)	1222		245.5	60
Gleiwitz (Germany)	1231		243.7	5
Cork (Ireland)	1235		242.9	1
Saarbrücken (Germany)	1249		240.2	17
Bilbao, EAJ8 (Spain)	1258		238.5	1
Riga (Latvia)	1258		238.5	15
Florence, No. 2 (Italy)	1258		238.5	1
Nürnberg (Germany)	1267		236.8	2
Radio Mediterranée (Juan-les-Pins) (France)	1276		235.1	27
Aberdeen	1285		233.5	1
Dresden (Germany)	1285		233.5	0.25
Klagenfurt (Austria)	1294		231.8	5
Vorarlberg (Austria)	1294		231.8	5
Danzig	1303		230.2	0.5
Swedish Relay Stations	1312		228.7	—
Magyarovar (Hungary)	1321		227.1	1.25

Station.	kc/s.	Tuning Positions.	Metres.	kW.
German Relay Stations	1330	.....	225.6	—
Lodz (Poland)	1339	.....	224	2
Montpellier, P.T.T. (France) ...	1339	.....	224	1.5
Dublin (Ireland)	1348	.....	222.6	0.5
Königsberg, No. 2 (Germany)	1348	.....	222.6	2
Rjukan (Norway)	1348	.....	222.6	0.15
Salzburg (Austria)	1348	.....	222.6	2
Tampere (Finland)	1348	.....	222.6	0.7
Nottoden (Norway)	1357	.....	221.1	0.3
Italian Relay Stations	1357	.....	221.1	—
L'Ile de France (France)	1366	.....	219.6	2
Basle (Switzerland)	1375	.....	218.2	0.5
Berne (Switzerland)	1375	.....	218.2	0.5
Warsaw, No. 2 (Poland)	1384	.....	216.8	7
Lyons (Radio Lyons) (France)	1393	.....	215.4	25
Stara-Zagora (Bulgaria)	1402	.....	214	2
Radio Normandie (Fécamp) (France)	1411	.....	212.6	15
Vaasa (Finland)	1420	.....	211.3	10
Alexandria, No. 2 (Egypt)	1429	.....	209.9	0.5
Turku (Finland)	1429	.....	209.9	0.5
Miskolc (Hungary)	1438	.....	208.6	1.25
Paris (Eiffel Tower) (France)	1456	.....	206	7
Pecs (Hungary)	1465	.....	204.8	1.25
Belgian Relay Stations	1465	.....	204.8	0.1
Bournemouth	1474	.....	203.5	1
Plymouth	1474	.....	203.5	0.3
Binche (Belgium)	1487	.....	201.7	0.1
Belgian Relay Stations	1492	.....	201.1	0.1
Nimes (France)	1492	.....	201.1	0.7
Albacete (Spain)	1492	.....	201.1	0.2
Santiago (Spain)	1492	.....	201.1	0.5
Belgian Relay Stations	1500	.....	200	0.1
Pietarsaari (Finland)	1500	.....	200	0.25
Radio Alcalá (Spain)	1500	.....	200	0.2
Karlskrona (Sweden)	1530	.....	196	0.2
Liepàja (Latvia)	1734	.....	173	0.1

SHORT-WAVE STATIONS OF THE WORLD

Station.	Call Sign.	kc/s.	Tuning Positions.	Metres.	kW.
Bombay (India)	VUB	3,300	.....	90.80	4.5
Bandoeng (Java)	PMY	5,150	.....	58.30	1
Caracas (Venezuela)	YV5RC	5,800	.....	51.72	1
Vatican City (Vatican State) ...	HVJ	5,970	.....	50.26	15
Moscow (U.S.S.R.)	VZSPS	6,000	.....	50.00	20
Mexico City (Mexico)	XEBT	6,000	.....	50.00	1
Montreal (Canada)	CFCX	6,000	.....	50.00	0.1
Pretoria (South Africa)	ZRH	6,000	.....	50.00	5
Havana (Cuba)	COCO	6,010	.....	49.92	2.5
Prague (Podebrady) (Czechoslovakia)	OLR2A	6,010	.....	49.92	30
Zeesen (Germany)	**DJC**	6,020	.....	49.83	5-40
Boston (U.S.A.)	W1XAL	6,040	.....	49.67	20
Miami (U.S.A.)	W4XB	6,040	.....	49.67	5
Daventry (Gt. Britain)	**GSA**	6,050	.....	49.59	10-50
Cincinnati (U.S.A.)	W8XAL	6,060	.....	49.50	10
Philadelphia (U.S.A.)	W3XAU	6,060	.....	49.50	10
Motala (Sweden)	SBO	6,060	.....	49.50	0.75
Vienna (Austria)	OER2	6,080	.....	49.41	1.5
Lima (Peru)	OAX4Z	6,080	.....	49.41	15
Chicago (U.S.A.)	W9XAA	6,080	.....	49.41	0.5
Nairobi (Kenya)	VQ7LO	6,080	.....	49.41	0.5
Delhi (India)	VUD	6,080	.....	49.41	—
Toronto (Bowmanville) (Canada) ...	CFRX	6,090	.....	49.26	0.5
Hong Kong (China)	ZBW2	6,090	.....	49.26	2.5
Capetown (South Africa)	ZRK	6,100	.....	49.20	5
Johannesburg (South Africa) ...	ZRJ	6,100	.....	49.20	0.2
Bound Brook (U.S.A.)	W3XAL	6,100	.....	49.18	15-35
Chicago (U.S.A.)	W9XF	6,100	.....	49.18	10
Belgrade (Yugoslavia)	YUA	6,100	.....	49.18	1
Daventry (Gt. Britain)	**GSL**	6,110	.....	49.10	10-50
Calcutta (India)	VUC	6,110	.....	49.10	0.5
Wayne (U.S.A.)	W2XE	6,120	.....	49.02	10
Pittsburg (U.S.A.)	W8XK	6,140	.....	48.83	30
Winnipeg (Canada)	CJRO	6,150	.....	48.78	2
San Jose (Costa Rica)	TIPG	6,410	.....	46.80	1
Amateurs	.....	7,000	.....	42.86	0.01
		to		to	
		7,300		41.10	
Tokio (Japan)	**JVP**	7,510	.....	39.95	50
Moscow (U.S.S.R.)	RKI	7,540	.....	39.79	25
Prangins (Radio-Nations) (Switz'l'd)	HBP	7,800	.....	38.48	20
Budapest (Hungary)	HAT4	9,125	.....	32.88	6
Prangins (Radio Nations) (Switz'l'd)	HBL	9,340	.....	32.10	20
Havana (Cuba)	COCH	9,430	.....	31.80	10
Madrid (Spain)	EAR	9,480	.....	31.65	10
Rio de Janeiro (Brazil)	PRF5	9,500	.....	31.58	12
Melbourne (Australia)	VK3ME	9,510	.....	31.55	2
Bangkok (Siam)	HS8PJ	9,510	.....	31.55	5
Daventry (Gt. Britain)	**GSB**	9,510	.....	31.55	10-50
Skamlebaek (Denmark)	OZF	9,520	.....	31.49	6
Pretoria (South Africa)	ZRH	9,520	.....	31.49	5
Hongkong (China)	ZBW3	9,520	.....	31.49	2.6
Jelöy (Norway)	LKC	9,520	.....	31.49	1
Schenectady (U.S.A.)	W2XAF	9,530	.....	31.48	25
Suva (Fiji)	VPD2	9,540	.....	31.45	0.4
Tokio (Japan)	**JZI**	9,540	.....	31.45	50
Prague (Podebrady) (Czechoslovakia)	OLR3A	9,550	.....	31.41	30
Zeesen (Germany)	**DJA**	9,560	.....	31.38	5-40
Lima (Peru)	OAX4T	9,560	.....	31.38	10
Millis (U.S.A.)	W1XK	9,570	.....	31.35	10
Manila (Philippine Isles)	KZRM	9,570	.....	31.35	1
Daventry (Gt. Britain)	**GSC**	9,580	.....	31.32	10-50
Lyndhurst (Australia)	VLR	9,580	.....	31.32	1
Philadelphia (U.S.A.)	W3XAU	9,590	.....	31.28	10
Sydney (Australia)	VK2ME	9,590	.....	31.28	20
Perth (Australia)	VK6ME	9,590	.....	31.28	2
Huizen (Holland)	**PCJ**	9,590	.....	31.28	60
Prangins (Radio-Nations) (Switz'l'd)	HBL	9,595	.....	31.27	20
Moscow (U.S.S.R.)	RW96	9,600	.....	31.25	20
Capetown (South Africa)	ZRK	9,600	.....	31.23	5
Sourabaya (Java)	YDB	9,610	.....	31.20	1
Rome (Italy)	12RO3	9,635	.....	31.13	25
Lisbon (Portugal)	CS2WA	9,655	.....	31.09	2
Buenos Aires (Argentina)	LRX	9,660	.....	31.06	10
Madrid (Spain)	EAQ1	9,860	.....	30.52	10
Lisbon (Portugal)	CSW3	9,940	.....	30.18	5
Ruysselede (Belgium)	ORK	10,330	.....	29.04	9
Buenos Aires (Argentina)	LSX	10,350	.....	28.99	12
Teneriffe (Canary Isles)	EAJ43	10,360	.....	28.94	4
Lisbon (Portugal)	CSW2	11,040	.....	27.17	5
Prangins (Radio-Nations) (Switz'l'd)	HBO	11,400	.....	26.31	20
Warsaw (Poland)	SPD	11,530	.....	26.01	20
Winnipeg (Canada)	CJRX	11,720	.....	25.60	2
Paris (Radio-Colonial) (France) ...	TPA4	11,720	.....	25.60	12
Huizen (Holland)	PHI	11,730	.....	25.5	25
Daventry (Gt. Britain)	**GSD**	11,750	.....	25.53	10-50
Zeesen (Germany)	**DJD**	11,770	.....	25.49	5-40
Boston (U.S.A.)	W1XAL	11,790	.....	25.45	20
Tokio (Japan)	**JZJ**	11,800	.....	25.42	50
Vienna (Austria)	OER3	11,800	.....	25.42	1.5
Rome (Italy)	12RO4	11,810	.....	25.40	25
Daventry (Gt. Britain)	**GSN**	11,820	.....	25.38	10-50
Lisbon (Portugal)	CWS4	11,840	.....	25.34	5
Zeesen (Germany)	**DJP**	11,850	.....	25.31	5.40
Daventry (Gt. Britain)	**GSE**	11,860	.....	25.29	10-50
Pittsburgh (U.S.A.)	W8XK	11,870	.....	25.27	24
Paris (Radio Colonial) (France) ...	TPA3	11,890	.....	25.24	12
Moscow (U.S.S.R.)	VZSPS	12,000	.....	25.00	20
Reykjavik (Iceland)	TFJ	12,235	.....	24.52	7.5
Warsaw (Poland)	SPW	13,635	.....	22.00	2
Amateurs	.....	14,000	.....	21.42	0.01
		to		to	
		14,400		20.84	
Sofia (Bulgaria)	LZA	14,970	.....	20.04	1.5
Zeesen (Germany)	**DJL**	15,111	.....	19.85	5.40
Vatican City (Vatican State) ...	HVJ	15,123	.....	19.84	25
Daventry (Gt. Britain)	**GSF**	15,140	.....	19.82	10-50
Bandoeng (Java)	YDC	15,160	.....	19.80	1.5
Daventry (Gt. Britain)	GSO	15,180	.....	19.76	10-50
Hongkong (China)	ZBW4	15,190	.....	19.75	2.6
Zeesen (Germany)	**DJB**	15,200	.....	19.74	5-40
Pittsburgh (U.S.A.)	W8XK	15,210	.....	19.72	20
Huizen (Holland)	**PCJ**	15,220	.....	19.71	60
Prague (Podebrady) (Czechoslovakia)	OLR5A	15,230	.....	19.70	30
Paris (Radio-Colonial) (France) ...	TPA2	15,243	.....	19.68	12
Boston (U.S.A.)	W1XAL	15,250	.....	19.67	10
Daventry (Gt. Britain)	**GSI**	15,260	.....	19.66	10-50
Wayne (U.S.A.)	W2XE	15,270	.....	19.65	10
Zeesen (Germany)	**DJQ**	15,280	.....	19.63	5-40
Buenos Aires (Argentina)	LRU	15,290	.....	19.62	7
Daventry (Gt. Britain)	**GSP**	15,310	.....	19.60	10-50
Prague (Podebrady) (Czechoslovakia)	OLR5B	15,320	.....	19.58	30
Schenectady (U.S.A.)	W2XAD	15,330	.....	19.57	18
Zeesen (Germany)	**DJR**	15,340	.....	19.56	5-40
Budapest (Szekesfehervar) (Hungary)	HAS3	15,370	.....	19.52	6
Zeesen (Germany)	**DJE**	17,760	.....	16.89	5-40
Wayne (U.S.A.)	W2XE	17,760	.....	16.89	10
Huizen (Holland)	PHI	17,770	.....	16.88	25
Bound Brook (U.S.A.)	W3XAL	17,780	.....	16.87	15-35
Daventry (Gt. Britain)	**GSG**	17,790	.....	16.86	10-50
Bangkok (Siam)	HS8PJ	19,020	.....	15.77	5
Zeesen (Germany)	**DJS**	21,450	.....	13.99	5-40
Daventry (Gt. Britain)	**GSH**	21,470	.....	13.97	10-50
Wayne (U.S.A.)	W2XE	21,520	.....	13.94	10
Daventry (Gt. Britain)	**GSJ**	21,530	.....	13.93	10-50
Pittsburgh (U.S.A.)	W8XK	21,540	.....	13.93	6
Daventry (Gt. Britain)	**GST**	21,550	.....	13.92	10-50

Recent Inventions

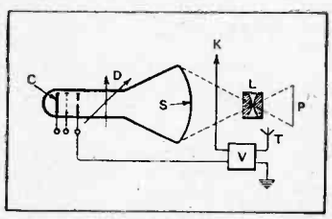
Brief descriptions of the more interesting radio devices and improvements issued as patents will be included in this section

TELEVISION SYSTEMS

WHEN a ray of light falls on to the photo-sensitive "mosaic" of a cathode-ray tube the resulting emission of electrons creates a charge proportional to the incident light on each mosaic cell. This in turn produces an electrostatic field, which is dissipated, or varied, by the action of the electron stream used for scanning the mosaic surface.

Similarly, when a ray of light falls on to a fluorescent surface a polarisation of the atoms, or of the fluorescent crystals, is said to occur, and to set up an electric field, which is also discharged or varied by the action of the electron stream used for scanning.

The result, therefore, of scanning either a fluorescent or photo-sensitive screen is to produce variations in the electrical field surrounding the screen. According to the invention the changes in field-strength induce currents (proportional to the original light intensity) in a "collecting electrode" situated outside the



Scanning systems for a television transmitter.

cathode-ray tube, and these are used to produce signalling currents.

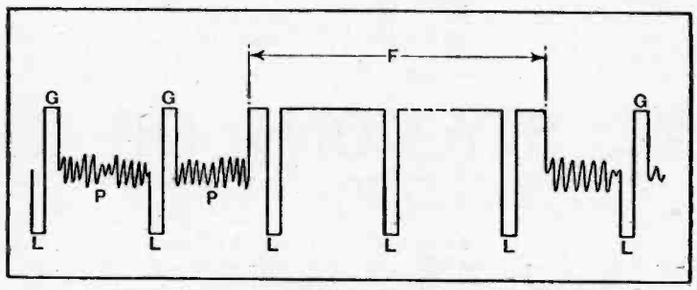
As shown, for example, in the figure, a picture P is focused by a lens L on to a photo-sensitive screen S, which is scanned in the ordinary way by the stream passing from the cathode C of the C-R tube through the usual deflecting plates D. The resulting variations in the electric field from the screen induce currents in an external "collector" K, which, after amplification at V, are radiated from the aerial T.

V. Zeitline, A. Zeitline and V. Kliatchko (Assignees of Cie pour la Fabrications des Compteurs, etc., à Gaz). Convention date (France) May 9th, 1935. No. 476865.

o o o o

WHEN transmitting television signals to or from a moving vehicle, such as an aeroplane or motor car, it is essential to provide an automatic and rapid method of gain-control, so as to offset the variation in signal strength with distance.

The Figure shows a typical train of signal impulses in which line-synchronising impulses L in the blacker-than-black direction are followed by gain-control impulses G of reversed polarity, i.e., extending in the whiter-than-white direction. Then comes a train P of picture signals, corresponding to one single scanning line, whilst the part F corresponds to the framing



Train of television signals described in Patent No. 476935.

impulse, which, in practice, extends for an interval corresponding to ten picture lines.

The various signals are separated out in the receiving set, and the signal impulses G, after being rectified, are used to control the sensitivity of one or more of the amplifying stages.

A. D. Blumlein. Application date, May 15th, 1936. No. 476935.

o o o o

PHOTO-SENSITIVE "MOSAICS"

IN a well-known method of television, the picture is first focused upon a photo-sensitive screen, or cathode, made up of a mosaic of small cells, which emit electrons under the action of the incident light and so become charged electrically. The scanning stream of electrons releases the cell charges, one by one, and so produces signalling currents.

It is, however, pointed out, that of the total electrons emitted, only a fraction is utilised, namely, those which are radiated during the short period of the scanning operation. The object of the invention is to make good this loss by storing-up the light energy from each cell during the interval between successive scannings on a "Lenard phosphor" screen. The latter is then scanned by a beam of infra-red light, which is synchronised with the ordinary electron scanning beam. This releases the whole of the stored-up energy so that it can be utilised for signalling.

The British Thomson-Houston Co., Ltd. Convention date (Germany), July 25th, 1935. No. 477216.

o o o o

DIRECTION FINDING

THE signal received on a frame aerial is combined with that from a vertical aerial in a common circuit, after each signal has been subjected to a common heterodyne frequency and passed through separate amplifiers. The directional voltage from the frame aerial is then applied in push-pull to a pair of rectifiers, to which the voltage from the vertical or non-directional aerial is applied in parallel. The output from the rectifiers feeds a centre-zero indicating device, so that any deviation to port or starboard of the craft carrying the equipment is at once registered.

In order to preserve the phase-relation between the directive and non-directive voltages required to give the well-known heart-shaped response, in spite of accidental variations in the values of the amplifiers and tuning impedances, the inventor now provides an adjustable phase-shifting device in the lead to the common circuit in which the two sets of signals are first combined.

F. J. Hooven. Application date March 3rd, 1936. No. 476721. (Addition to 472111.)

o o o o

WHEN taking wireless bearings from a moving body such as a ship or an aeroplane, it is necessary to make allowance for an inherent discrepancy between the true direction and that shown on the indicator. This is due to the reflection of the incoming waves from the metal parts of the vehicle, and since the effect differs with the direction of the incoming signal, in a cyclic manner, it is known as "quadrantal error." In practice it is corrected by adding to, or subtracting from the apparent readings, a fraction which is determined by a sinusoidal curve initially graphed-out for each individual craft, in much the same way as magnetic error is compensated for in a ship's compass.

In the drawing (a) shows a scheme for applying the correction automatically. A "quadrantal error curve" C is drawn out on a cylinder P, so that it takes the place of the usual index pointer. As shown in (b), the cylinder is driven by a gear wheel W from the shaft S which carries the frame aerial. The intersection of the curve C on the graduated scale gives the correct reading.

Marconi's Wireless Telegraphic Co., Ltd. and R. J. Kemp. Application date, June 25th, 1936. No. 477346.

o o o o

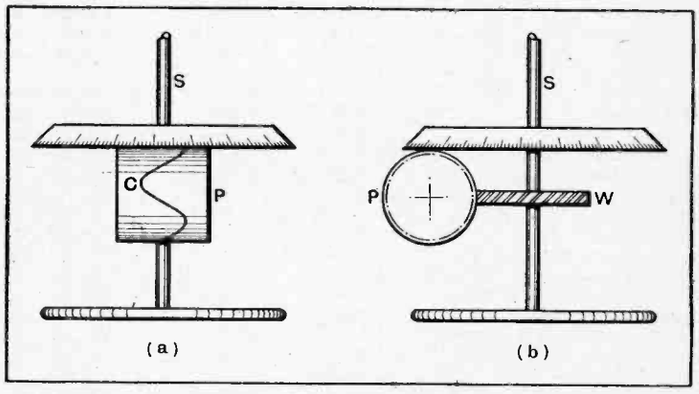
THE field and search coils of a radio-goniometer are both fitted with powdered-iron cores, for the sake of compactness, whilst the search coil is wound in two parts, which are relatively adjustable in order to compensate for octantal error. Shunt coils, also fitted with powdered-iron cores, are arranged to compensate for one type of quadrantal error, whilst magnetic shunts eliminate a second variant of the same type of error. An auxiliary winding, coupled to one of the field coils, allows any initial lack of symmetry between the coils to be corrected.

C. Lorenz Akt. Convention dates (Germany), January 24th, and September 24th, 1936. No. 478395.

o o o o

CATHODE-RAY TUBES

A TRIPLE set of electrodes is arranged inside a cathode-ray tube to enable three separate streams of electrons to be independently controlled, at least so far as their vertical traverse over the screen is concerned. One pair of deflecting plates controls all three streams simultaneously during the lateral scanning movement over the screen. The deflecting-plates are operated in push-pull, about the anode voltage as zero, in order to prevent undesirable interaction between the separate streams.



Method of compensating in DF equipment for "quadrantal error."

Radio-Akt. D. S. Loewe. Convention date (Germany), June 20th, 1935. No. 477043.

The British abstracts published here are prepared with the permission of the Controller of H.M. Stationery Office, from Specifications obtainable at the Patent Office, 25, Southampton Buildings, London, W.C.2. price 1/- each. A selection of patents issued in U.S.A. is also included.

The Wireless World

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As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

CONTENTS

	Page
Editorial Comment	325
Sunset and Fading	326
Phase-Shift Measurement	329
Television Topics	331
News of the Week	332
New Time Base	334
New Apparatus Reviewed	336
Unbiased	337
Eddystone E.R.A.7 Reviewed	338
Readers' Problems	340
Voltage Stabiliser	341
Letters to the Editor	342
On the Short Waves	342
Random Radiations	344
Recent Inventions	346

EDITORIAL COMMENT

Noise in Receivers

Why Wait for Legislation?

WHILST we are continually being promised that the Government Bill destined to give the Postmaster-General authority to control electrical interference with wireless reception is just round the corner, time drags on and still we wait.

The preparation for the Bill has progressed so far that we are entitled to look forward with confidence and a reasonable amount of certainty that legislation on this subject will ultimately come and so help to relieve the interference problem for the future.

In our opinion, however, not nearly enough is done at present by way of trying to improve reception conditions by methods which can be applied at the receiving end. We know that this is a comparatively expensive method when perhaps a hundred or so receivers have got to be dealt with individually, whilst the remedy for the interference, if tackled at the source, would in many cases involve no greater expenditure than the cost of tackling the interference at one of the hundred points of reception. Nevertheless, we think it is unfortunate that service men are not more alive to the fact that all over the country there are those who have abandoned listening to wireless and will no longer entertain the idea of either a new set or an overhaul of the old one, simply because they have been disgusted with the continual interference to which they have been subjected.

In very many cases, if the service man were active in applying proper remedies at the receiving end much, and in some cases all, of the interference could be removed.

The listener requires from those called in to attend to his set more than technical service. If listeners, disgruntled because of the interference they have been experiencing, are to be brought back, as it were, into the fold, and have their interest in wireless renewed, the service man should be ready to remind them of the Post Office interference complaint forms and help them in filling them up and, in fact, do everything in his power to assist in giving the listener the best reception possible free from troubles of electrical interference.

Post Office Help

Whilst discussing this subject we would like to pay a special tribute to the Post Office for the work which they are doing in the interests of the listening public. Not only are their energies directed towards eliminating these troubles wherever possible, but, in addition, the technical staff is making a close study of every aspect of interference so as to be able to give advice.

A paper read recently before the Wireless Section of the Institution of Electrical Engineers, by Mr. A. J. Gill and Dr. S. Whitehead, briefly referred to elsewhere in this issue, is an excellent example of the thoroughness of Post Office methods. The paper is a comprehensive summary of the present state of knowledge on the subject of electrical interference and its elimination in very many branches.

Even when legislation goes through, nobody can expect that electrical interference will disappear as if by magic. It will take years to make the legislation really effective throughout the country, and with interference steadily growing as it is at present, it is a poor lookout for wireless reception in some districts if distributors of sets and service men continue to be indifferent to the problem and leave the listener to think that the noises in his set are an integral part of broadcast reception.

Sunset and Fading

More Measurements of Signal Strength

By "CATHODE RAY"

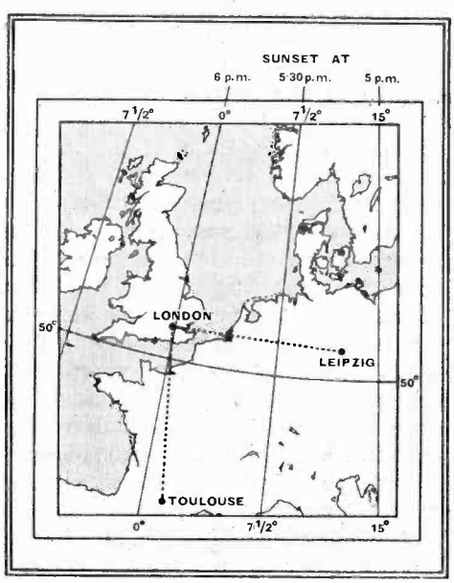
AT the end of last year (in *The Wireless World* of Dec. 30th) some results of measuring the signal strengths of broadcasting stations were published. It was impossible not to take some account of fading, because all except the nearest stations are more or less subject to it, and the signal strength measured at one moment may be quite different from that taken an hour, minute or even a second later. At the time, I was concerned with giving typical strengths received by a typical outdoor aerial, and the variations in strength were given only the broadest classification—day and night. But in pointing out that the published results are subject to very large variations I promised to deal more particularly with fading later on.

Of course, the subject is even vaguer than the length of an unspecified piece of string. There are hundreds of stations, and reception from them by any given aerial is constantly changing, and there are dozens of conditions—time of day and year, weather, frequency, distance, position, etc.—that might have some influence on the results. But, by comparing results when all except perhaps one of the conditions are the same, it may be possible to trace the influence of that one.

We all know that, on the average, the most marked change in signal strength is that which corresponds to the difference between daylight and darkness. That is why in the previous article I gave separate day and night figures. A receiver that brings in half a dozen stations during daylight usually gives scores, at least, after dark.

So it ought to be interesting to study the change-over from daylight to darkness conditions. Does it coincide with sunset? And, if so, is it sunset at the receiving end or the transmitting end or somewhere in between?

To eliminate questions of distance, frequency, and power, I looked for a pair of stations in which these quantities are the same. Of course, it would be no good if they were *exactly* the same frequency, but a difference of one or two per cent. isn't likely to influence the general results very profoundly. To make the approach of sunset as different as possible (so as to concentrate attention on it) I looked for a pair in which one station lies due east and another due south. The best pair seemed to be Leipzig and Toulouse. They are both rated at 120 kW. They work on adjacent channels (776 and 785 kc/s). They are free from local-station or shared-channel interference (Leipzig is exclusive, and Toulouse shares a channel with two comparatively small and very remote stations from which nothing could be detected). They are both about 550 miles from London. Leipzig is almost due east, and Toulouse is nearly due south. So one is in the line of approaching sunset, and the other is at right angles to it; the sun sets nearly an hour sooner at Leipzig, but almost simultaneously at Toulouse.

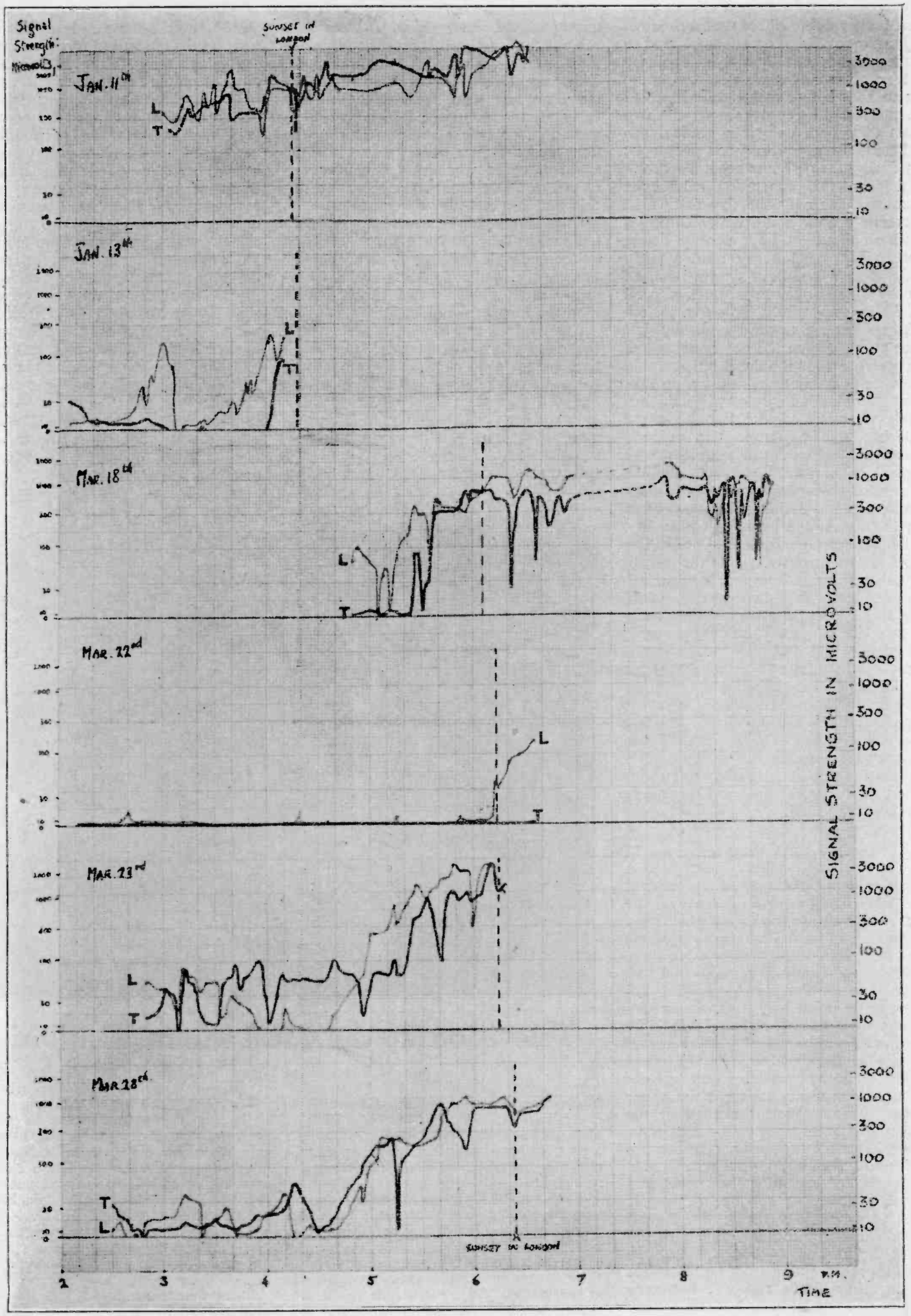


Leipzig and Toulouse, the transmitters on which observations were made, lie respectively east and south of the receiving station in London. Relative times of sunset are shown.

Actually I had taken quite a lot of readings before I realised that the last statement is true only twice a year—at the spring and autumn equinoxes. A little playing about with a terrestrial globe showed that in mid-January (when the first results were obtained) the edge of the sunset shadow crosses Europe obliquely, and, moreover, the low angle of the sun in relation to that part of the earth makes the transition from day to night very gradual, which might be expected to obscure the intended observations. So (as an Editorial note announced) the experiment was postponed until the spring equinox (March 21st).

The method of measurement was described in the Signal Strength article, so I need only say that the signal picked up by a typical outdoor aerial by means of a highly selective receiver was read on a microammeter in the detector circuit, and the whole arrangement was calibrated in microvolts in the aerial by a standard signal generator. It is not claimed that every minor fluctuation in strength was noted, but by taking readings sometimes as close as half-minute intervals the extent and shape of the major fades is shown fairly reliably on the graphs. There was no rapid fading such as is common on the short waves.

Some results taken in January are presented here as a matter of interest and certainly do not encourage hopes of dis-



Strength of signals from Leipzig and Toulouse as received in London at around the time of sunset : L, (light line) Leipzig ; T, (heavy line) Toulouse.

Sunset and Fading—

covering any clearly defined effect of the different approaches of the sunset shadow. On January 11th both stations seemed to have reached practically night strength by the time observations were started, more than an hour before sunset. And instead of a marked difference between the two signals they both exhibit a gradual upward trend from 300 to 3,000 microvolts (μV) during the $3\frac{1}{2}$ hours around sunset.

Yet even this conclusion cannot be generalised, for only the day after next the results are quite different. During a period of about an hour shortly before sunset, when, on January 11th, a fairly steady 300 μV had been shown, now, on January 13th, Toulouse is practically nil and Leipzig is wildly irregular. Both stations show an upward tendency just before sunset (when the observations had to be given up for the day), but it would be unwise to base any conclusion on this.

Now for glorious spring, when the approach of sunset can be traced without headaches due to having to struggle against the astronomical problem with spherical trigonometry. At the equinox the sun sets everywhere at six o'clock (local time), and darkness takes nearly an hour to traverse the Leipzig-London line, but swallows up the Toulouse-London line almost instantaneously. Does the growth of received signal show any corresponding difference in these two extreme cases?

On March 18th there seemed to be some evidence that it does. Toulouse provided a negligible signal until 5.30, when it sprang up in a matter of minutes to a 300 μV level and remained thereabouts (except for occasional deep fades) until the test was shut down at 9 o'clock. It never came near 3,000 μV as it did on January 11th. Leipzig, on the other hand, gave a strongish signal before 5, and increased more gradually, just as might have been expected.

Inexplicable Fade-out

Alas for hasty conclusions! A few days later, when readings were taken with the apparatus unaltered, no measurable signal was obtainable from Toulouse at any time from 2 o'clock until lighting-up time, though a faint sound showed that the station was not shut down. Leipzig appeared to be smitten by the same evil influence and was nearly as bad, giving only occasional faint bursts of reading before sunset, when the signal suddenly increased to what would be considered quite a large amount if one did not look at the upper graphs. If any violent change in the weather had intervened one might have blamed it for the extraordinary difference in reception. But both days were included in a period of exceptionally settled and tranquil weather.

The very next day the results showed a complete change-around, different from any of the foregoing. For a long time before sunset reception from both stations was anything up to 100 μV, but very irregular. I mentioned last time how these tests destroyed the belief I had held that daytime reception, though weak, was consistent, while night-time reception was strong but subject to fading. Here once more it can be seen that reception by daylight is far more unreliable than at night. This day (March 23rd) Leipzig is decidedly worse than Toulouse during the early afternoon. Note that both signals exceed 3,000 before sunset. During the hour or so before sunset there is some slight trace of what was hopefully observed on March 18th. But any faith in this that has not already been destroyed by the March 22nd results is completely extinguished by March 28th, where it is quite impossible to detect any tendency for the growth of the Toulouse signal to increase more suddenly and nearer sunset than the Leipzig signal.

Can we draw any conclusions other than that there are no conclusions? One thing that seems to be consistent, especially if the earlier results on other stations are included, is that daylight reception is not only weaker than at night, but is usually more irregular. Quoting from my previous article, "Daylight fading generally consisted in the strength fluctuating widely and irregularly all over the place, whereas at night the same stations faded downwards from some more or less definite high level." No need to alter that.

Another thing is that the influence, if any, of gradual or sudden onset of darkness over the country between transmitter and receiver is swamped by other influences that are not traceable from these experiments. Some readers may be able to suggest something, but personally I can think of nothing that is adequate to account for the fact that at ten to six p.m. on March 22nd, 1938, no measurable signal could be detected from either Toulouse or Leipzig, whereas at the same time the very next day, with no visible change in the weather or anything else, both signals were coming in at over 1,000 microvolts. Local station reception was identical each day, showing that nothing funny had happened to the receiver or aerial.

Another conclusion is that to make sure of this sort of experiment one would have to do it every day for several years, and even this might not arrive at positive results. Nevertheless, negative results are not to be despised.

Television at the Ideal Home Exhibition

A TELEVISION section is included in this year's *Daily Mail* Ideal Home Exhibition at Olympia. The main exhibit is a replica of a television studio, and it is glass-enclosed so that visitors can watch artistes being televised without hindering in any way the activities of the engineers and studio staff.

This studio can in no sense be called a working model; on the contrary, it is much more nearly the real thing, and during certain hours visitors can walk round the corner to the television receivers and see on their screens the artistes they have just left in the studio. Adjacent to this studio is a small "make-up" room, of which one side is again of glass. Here the artistes can be seen undergoing the process of being "made-up" for television preparatory to their appearance in the studio.

During the normal hours of television transmission the picture emanating from the Alexandra Palace is reproduced on the television receivers. These are situated in the entrance to the television exhibit, and are the products of six manufacturers: Baird, Cossor, G.E.C., H.M.V., Marconiphone, and Murphy. Outside the normal transmitting times these receivers give a picture produced in the adjacent studio. At times, however, this local studio programme will be sent to Alexandra Palace by a radio link, and will be radiated as part of the normal programme.

Phase-Shift Measurement

SIMPLE APPARATUS FOR FREQUENCIES UP TO 10 MC/S.

By SIGURD ZIENAU

THE author describes an arrangement of two valves in push-pull, which, with the addition of a diode voltmeter, may be used for measuring both the gain and phase-shift of an amplifier.

THE problem of phase-shift has greatly increased with the advent of video-frequency amplification. For the distortion-free reproduction of television signals it is absolutely necessary that the phase-shift in the apparatus be a linear function of frequency. Actually a flat phase-shift curve is also of more importance than one is apt to think in ordinary IF and RF amplifiers. Phase modulation or a twist in the modulation envelope can occur when the phase-shift varies with frequency.

By now, however, these problems have been realised and many research workers have paid attention to the subject. It is quite feasible to calculate the phase-shift in an amplifier, and, on the basis of this calculation, to design the amplifier in such a way that both gain and phase characteristics are flat over the desired frequency range. However, it is always very convenient to be able to measure the actual phase-shift in amplifying gear. Many circuits have been evolved for this purpose and have been fully analysed elsewhere. It is the intention of the writer to give an outline description of one of the simpler types of apparatus, suitable for this purpose, which incidentally will also serve as a stage-gain measuring device up to frequencies of the order of 10 Mc/s.

The basic problem is to arrange a circuit that will vectorially add up the input voltage and the output voltage of the amplifier under test. A push-pull circuit with the anodes in parallel and the output connected to a voltage measuring device will do this trick extremely well. The outline circuit will, therefore, look as shown in Fig. 1. In this figure, V2 is the input voltage to the amplifier, V1 its output voltage. The voltmeter in the output circuit will, of course, measure the amplified result of the two inputs, V. The phase angle θ is then given by the expression $\cos\theta = \dfrac{V^2-(V2^2+V1^2)}{2\,(V2\times V1)}$

In the case that V1 equals V2,

$$\text{then } 2\cos\tfrac{1}{2}\theta = \frac{V}{V1}$$

In actual practice a diode voltmeter replaces the voltmeter V. Also pentodes are mostly used instead of triodes, for it is easy by means of screen potential adjustments to balance them out. The circuit of a practical valve voltmeter would look somewhat like Fig. 2. In some cases it would be advisable to use grid stoppers to reduce any tendency to oscillate. By shorting out one section it is possible to use the apparatus as a straightforward valve voltmeter. As an attenuator is needed in any case, the voltmeter can be used to measure the gain of the amplifier at the same time, as will be described below.

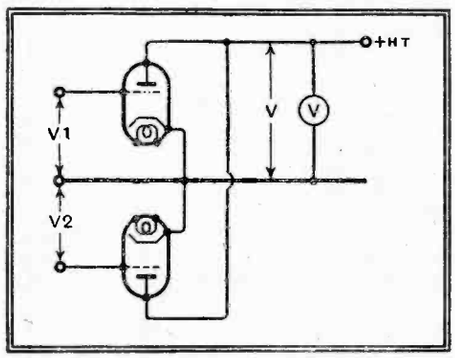


Fig. 1.—Simplified circuit of an arrangement for measuring phase-shift and stage gain.

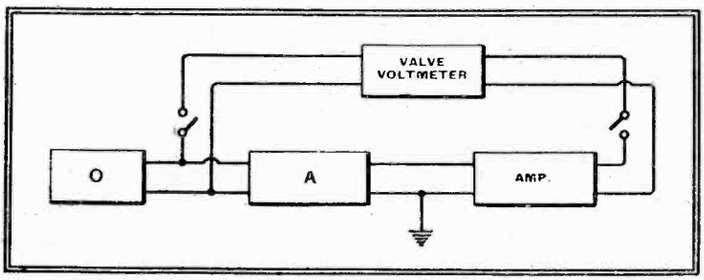


Fig. 3.—Block diagram showing method of measuring stage gain. AMP, amplifier under test; A, attenuator; O, oscillator.

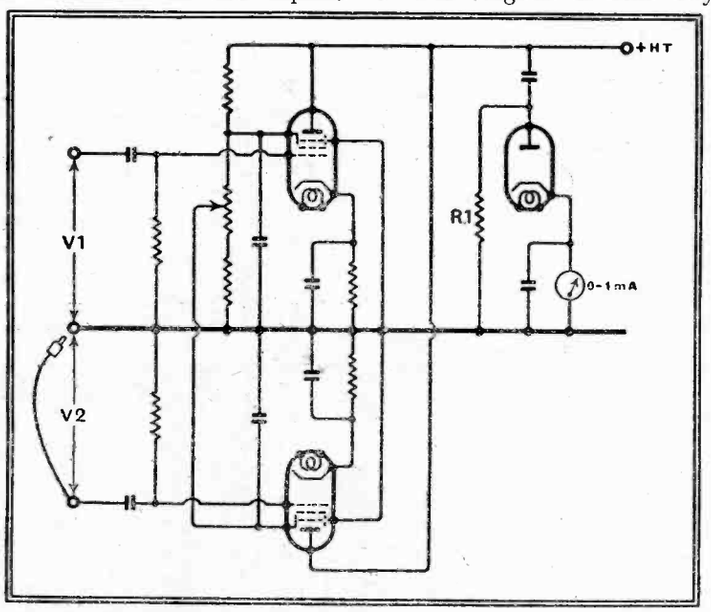


Fig. 2.—Circuit of practical measuring equipment, comprising the push-pull valves of Fig. 1, plus a diode voltmeter valve. Component values as in standard practice.

In our equations for the phase angle we have assumed the input voltage to the amplifier under test to be equal to its output voltage. This assumption sounds rather absurd when it is remembered that the purpose of amplifiers is to amplify signals in some way or other. A little thought will show, however, that the condition mentioned can be brought about by the interposition of an attenuator between test signals and amplifier. If the loss in db. of this attenuator is such that the input to it will equal the output of the amplifier, then the gain of the latter in db. is equal to the loss in the attenuator. Fig. 3 shows the hook-up for these measurements. For the purpose of our phase-shift measurement the attenuator has, of course, to be designed and constructed in such a way as not to introduce any phase-shift of its own. There is not much difficulty in this, and the real problem lies in the frequency range which the equipment is required to cover.

Effect of Valve Capacities

With regard to frequency range, it will be realised that, as the valve anodes are in parallel, the valve input capacities are also virtually in parallel, thereby adding up. The sensitivity will, therefore, begin to drop in the vicinity of one or two Mc/s. As, however, both valves fall off in sensitivity at the same rate, the accuracy of measurement will not be impaired. If a higher frequency than 10 Mc/s is wanted, a more sensitive meter will have to be used in the diode circuit, and the value of the diode load resistance becomes

Phase-Shift Measurement—critical. So much for the valve voltmeter. Returning to the matter of the attenuator, it can safely be said that a resistance element filter will do its job up to about 2 Mc/s. Above that the self-capacity and self-inductance of the resistances becomes annoying. An "inverted L" type of resistance filter can be used and about six sections totalling sixty db. will suffice for almost anything (Fig. 4). The question of characteristic impedance is of importance.

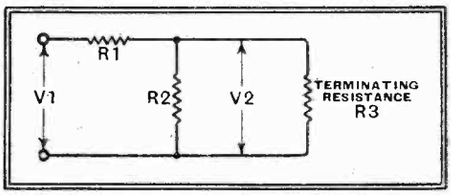


Fig. 4.—An "inverted L" resistance filter section for the attenuator. Calculation :

$$\frac{V_1}{V_2}=k \text{ (attenuation)}$$

$$R_1=R_3(1-k)$$

$$R_2=\frac{k\,R_3}{1-k}$$

The input resistance of amplifiers varies appreciably, and for flexibility and frequency range a compromise has to be made. Without going into further details, it may be stated that 100 to 200 ohms will serve quite well. The attenuator has, of course, to be terminated with this resistance. Above 2 Mc/s an attenuator consisting of capacity branches must be used. Such a unit can again be of the "inverted L" type, and its calculation is surprisingly simple, as the example shows (Fig. 5). In the interest of stability it is better to use this attenuator between the amplifier and the valve voltmeter; for the filter can then work into the constant input capacity of the first valve (which becomes the terminating capacity).

Construction and Calibration

While the writer does not propose to give constructional details of a complete unit, some points which have to be observed in the construction and calibration of the valve voltmeter and associated gear might be of interest to readers. There should be no difficulty in making the valve voltmeter work, at least up to frequencies of about 2 Mc/s. For a higher frequency range symmetry in the layout of the push-pull stage is very desirable. It must not be forgotten that equal stray capacities in both arms are essential for accurate measurements of gain or phase-shift at the lower wavelengths. For very accurate determination of phase-shift, it is also better to use battery bias instead of cathode bias. Any pentode should work in the circuit; but a high mutual conductance valve is most probably best, and the valves ought to be identical in characteristics as far as possible. The final balancing can be done by means of the screen potentiometer. A triode can be used as diode rectifier and some experimenting with the load resistance R1 is advisable for best results. A value between one and five megohms is suitable.

As for the attenuator, a resistance type for use up to 2 Mc/s is quite easy to construct. Readers are reminded that good screening is necessary and the different stages ought to have exactly the same layout. Carbon resistances will do when very great accuracy is of no importance. They have the advantage that their ohmic value can be adjusted by filing them. A capacity attenuator represents a considerably more difficult problem. The single sections should be well screened from each other, while switches with good insulation should be used. All leads should be as short as possible and mica condensers are essential. Even though great care has been taken and good components have been used, the results may be disappointing. This may be due to several reasons: defective screening, excessive stray capacities, excessive capacity between the earthed aluminium box and components, and, last but not least, badly insulated switches which allow leakage currents. These defects are not easy to get over, and only readers who are accustomed to high-frequency work are advised to attempt the construction of this unit.

Decibel Readings

For the calibration, an existing calibrated attenuator and an amplifier are necessary. The diode current meter (which can be a 0—1 mA meter) is then calibrated in decibel gain. Once the meter has been calibrated in db. it is easy, with the help of the formula, to take phase-shift measurements. It is difficult to predict what results can be expected from this type of apparatus. A great deal will depend on how much care has been taken in the construction and how well the push-pull stage is balanced. Provided these points have been observed, the accuracy obtainable, so far as gain measurements are concerned, ought to be good enough for any ordinary requirements. Up to about 2 Mc/s, the same goes for the phase-shift measurements. Above that, results will vary with individual apparatus, but most of them should give reasonably accurate readings up to 10 Mc/s.

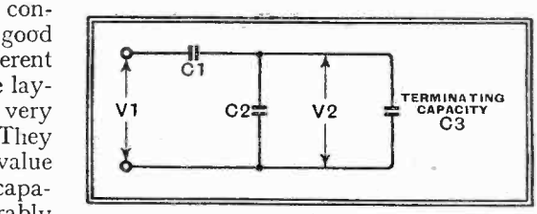


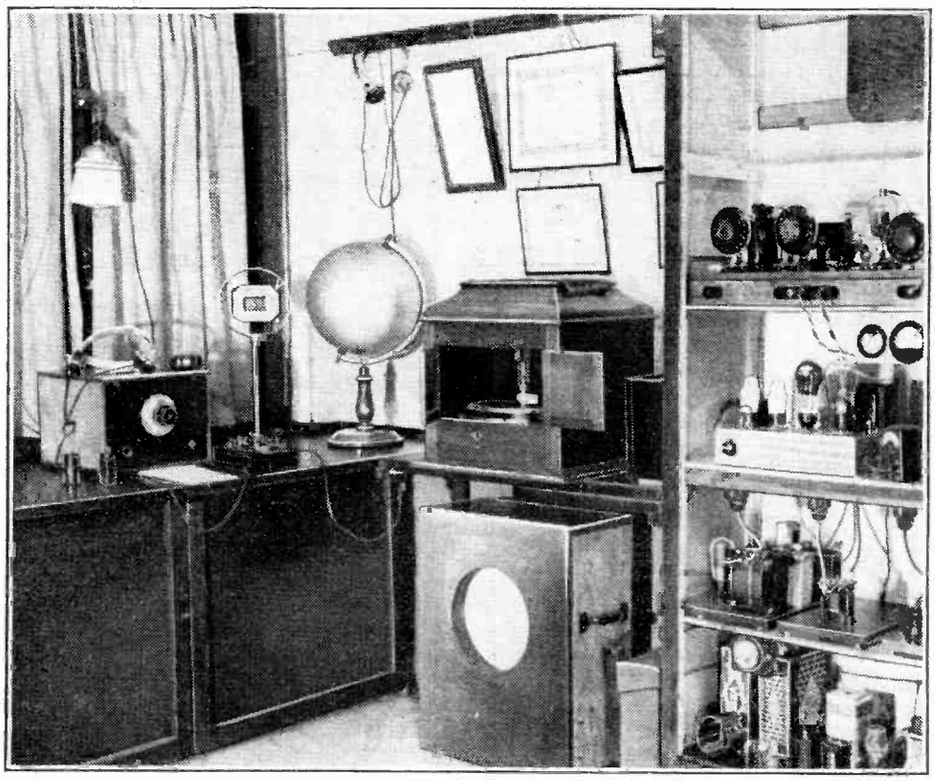
Fig. 5.—Capacitative "inverted L" filter section. Calculation :

$$\frac{V_1}{V_2}=k$$

$$C_1=\frac{C_3}{1-k}$$

$$C_2=\frac{C_3(1-k)}{k}$$

ALL CONTINENTS ON TEN WATTS



WORKMANLIKE AMATEUR STATION.—G5RL, at St. Ives, Hunts, owned by Mr. B. K. Rowell, has been operating since 1934 on the 20-, 40-, 80- and 160-metre bands; apparatus for the 5-and 10-metre bands is in course of construction. With a 10-watt input and a "straight" two-valve receiver, the station has "worked all continents" and "worked the British Empire."

Television Topics

SAW-TOOTH OSCILLATORS

PROBABLY the most widely used generator of the saw-tooth waveforms needed for scanning is the gas-filled triode. At one time this valve had the reputation of being erratic in operation, and consequently unsuitable for use in the line time-base. This criticism is no longer applicable, however, and there are now many gas-triodes which have been specially developed for television and which give very reliable operation. In general, the mercury-filled type is unsuitable for time-base work, and helium, argon, and sometimes neon fillings are used.

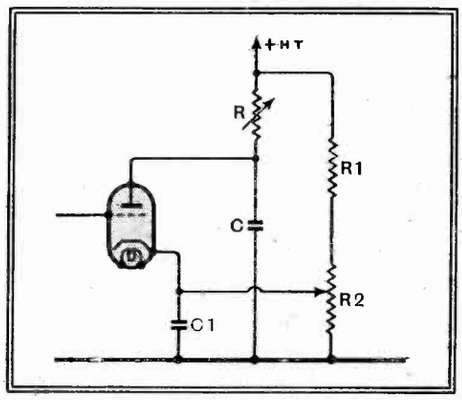


Fig. 1.—The basic circuit of a saw-tooth oscillator using a gas-triode.

The great point about a gas-triode is that it is essentially non-conductive until the anode voltage exceeds a certain figure. When this happens, the gas ionises and the valve has an exceedingly low internal resistance. It remains conductive, moreover, until the anode voltage falls below another and lower critical voltage, usually some 10-20 volts.

These critical voltages depend primarily upon the construction of the valve and the gas pressure, but the higher critical voltage, or striking voltage as it is usually called, depends also upon the grid potential. With a certain negative grid potential the valve will strike, i.e., become conductive, at a certain anode voltage. If the grid is made more negative, a higher anode voltage is needed to make the valve conduct, and conversely with a less negative grid it will strike at a lower anode voltage.

Now if we have on the anode a certain voltage which is less than the striking voltage and change the grid potential to make it more negative, nothing will happen in the anode circuit. If we make the grid potential less negative in sufficient degree, however, the valve will strike. Changing the grid potential in a positive direction, therefore, will initiate the discharge.

On the other hand, if the valve is conducting the grid will not exercise any control. Although quite a small change of grid potential may suffice to initiate a discharge, once it has started it cannot be stopped by any variation in the grid voltage; it can only be stopped by bringing the anode voltage below the lower critical figure. When the discharge has ceased, the grid regains control and is again capable of starting a further discharge.

The basic circuit for a gas-triode saw-tooth oscillator is shown in Fig. 1; R1, R2, and C1 are used merely to provide grid bias and can be ignored for the moment. Starting with the valve in the non-conductive condition, the condenser C charges through R from the HT supply. The voltage across C, and hence the anode voltage of the valve, therefore, rises. At a certain critical voltage the valve strikes, and as its resistance is then very low compared with the value of R, the condenser discharges through the valve very much more rapidly than it was charged through R. As the condenser discharges the voltage across it falls and the discharge ceases when the voltage has fallen to the lower critical value of the valve.

One period of saw-tooth oscillation is made up of one charge and one discharge of the condenser; that is, of one scanning stroke and one fly-back. The relative times occupied by these two portions of the cycle depend primarily upon the relative values of the charging resistance R and the internal resistance of the valve when conducting. For television line scanning the discharge time must not be greater than 15 per cent. of the total period of oscillation.

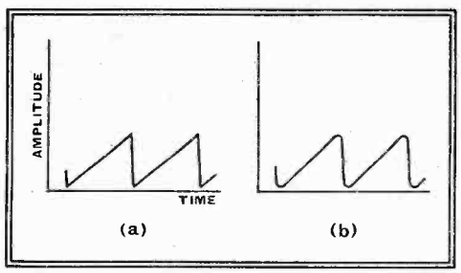


Fig. 2.—The ideal saw-tooth waveform is shown at (a) and at (b) a more practical form.

The internal resistance of a gas-triode is so low that there is no difficulty in meeting this primary condition. At high operating frequencies, however, another effect comes into play. The action of the valve depends on the alternate ionisation and de-ionisation of the gas and the accomplishment of this requires time. When the voltage on the anode rises to the striking value, the gas does not ionise immediately, but requires a small time interval. There is consequently a delay in the beginning of the discharge of the condenser. Similarly at the end, when the voltage has reached the lower critical value there is a delay before the condenser begins to charge again, because a small time is needed for de-ionisation of the gas.

The result of this is to make the saw-tooth wave tend more to the form shown with great exaggeration in Fig. 2 (b) than the ideal form of (a). It is also obvious that it increases the portion of the time of the cycle of oscillation which must be allowed for the fly-back. Furthermore, it sets an upper limit to the frequency at which a gas triode will operate.

For present television the line time-base must work at 10,125 c/s, and suitable gas-triodes will readily operate at this frequency and give an adequate fly-back time. Indeed, it is not difficult to find types which will operate at considerably higher frequencies.

Some years ago it was actually difficult to obtain gas-triodes which would function reliably at the frequencies necessary for television line scanning. Consequently, circuits using ordinary hard valves were often adopted, and in the minds of many people are still considered more reliable. In the writer's experience, however, the gas-triode is entirely satisfactory for television and has been for a year or two now.

The chief disadvantage of the gas-triode is its high price in comparison with a hard valve, and for this reason the latter is often adopted in spite of its requiring a more complicated circuit. There are very many ways of using hard valves as saw-tooth oscillators, and in some arrangements very high operating frequencies can be obtained, far beyond anything possible with the gas-triode. They are, therefore, of considerable importance, apart from television, for use in cathode-ray oscillography. The problem is, in general, to use one or more hard valves in such a way that they simulate the action of the gas-triode, and it is hoped to describe some of the more important arrangements in further articles.

B.T.H. Sound Amplifying Equipment

IN the latest sound reinforcing equipment for large halls, developed by the British Thomson-Houston Co., Ltd., Rugby, volume expansion or volume contraction circuits may be switched in at will in the amplifiers.

The reproducing equipment comprises an assembly of 16in. cone loud speakers for low-frequency response and metal diaphragm high-frequency units working into multi-cellular horns. The microphones used for PA work with this new installation are of the directional straight-line characteristic ribbon type.

INTERFERENCE: A Comprehensive Survey

Its Nature, Propagation and Suppression

AN important paper entitled "Electrical Interference with Radio Reception," by Mr. A. J. Gill and Dr. S. Whitehead, both of the G.P.O., was read last week before the Institution of Electrical Engineers. The nature, propagation, assessment, and measurement of interference, as well as the suppression of all the serious kinds, were dealt with in a most comprehensive manner, especially from the technical point of view, to which aspect the subsequent discussion was mainly confined.

Points from the Paper

At the present time . . . a member of the general public who finds his radio reception interfered with or possibly spoilt has no redress, apart, possibly, from applying in the High Court for abatement of nuisance.

Interference arising from the operation of a trolley-bus is mainly radiated from the overhead contact wires, along which the disturbances are propagated.

Domestic appliances: the normal path of interference is from the offending item via the supply mains to the vicinity of the receiving aerial whence it is radiated from unscreened portions of the wiring and picked up by the aerial-earth circuit of the receiver.

Ignition interference: the efficiency [of suppressor resistances] can be very considerably increased by covering a short length of the lead at the plug end by a screen of metal foil . . . so as to form a small condenser of about 20 m-mfd., the foil being bonded to the cylinder block.

Wherever possible an outside aerial should be used, as this not only possesses a lower coupling with the supply mains but at the same time can have a much greater effective height than the indoor aerial. . . . Frame aerials of the small type . . . are inefficient compared with the outside aerial . . . their directional proportions are rarely effective against interference.

In the case of flats where individual outdoor aerials are impossible, the best solution appears to lie in the provision of a single efficient aerial at the top of the building associated with a wide-band amplifier, to the output of which a feeder is connected which is brought into every flat.

The use of filters at the point of entry of supply mains is a valuable aid towards the prevention of interference from plant outside the building.

Points from the Discussion

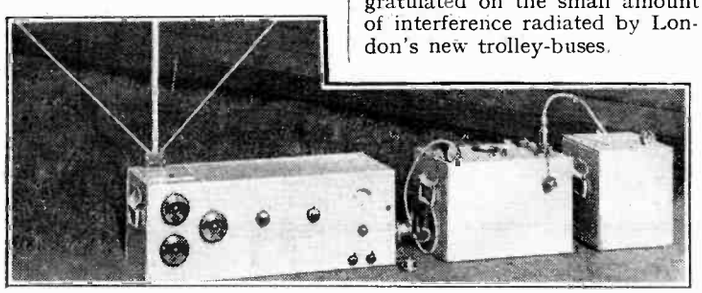
Manufacturers of electro-medical HF apparatus might standardise on a frequency of about 50 Mc/s in order to restrict interference to that band.

Interference from ignition systems falls off very rapidly as wavelength is reduced below the lower limit at present in general use.

Listeners should be educated to the use of better aerials, and landlords should not have the power to force them to use inefficient ones.

It would cost about £2,000,000 to suppress the ignition systems of motor cars in this country.

The L.P.T.B. is to be congratulated on the small amount of interference radiated by London's new trolley-buses.



FOR INVESTIGATING IGNITION INTERFERENCE. This new short-wave interference measuring set, made to the design of the Electrical Research Association by Belling and Lee, covers a wave-range of from 6 to 25 metres. Two single-turn diamond shaped frame aerials are used, and double screening is employed. The instrument was exhibited at last week's I.E.E. meeting.

NOTTINGHAM'S NEW STUDIO—A SCHOOL HALL

NOTTINGHAM had a relay station in 1924, but was deprived of that facility eight years later. A virile agitation has been constantly fanned by Nottingham listeners, and B.B.C. spokesmen have frequently been earmarked to go down and tell them why Nottingham's ambition to have a studio could not be gratified. Now the battle has been partially won. The B.B.C. has made arrangements with the Park Hill Congregational Church, Derby Road, Nottingham, whereby the Corporation has the use of the school hall and other rooms connected with it for a minimum of twenty-five occasions in each year for broadcasting. The arrangement is for three years from March 25th last.

NEWS OF

NEW BROADCAST WAVELENGTHS

Recommendations from Cairo

THERE is to be a "little Cairo" as there was a "little Madrid," for as the outcome of the Cairo Telecommunications Conference a European wavelength conference is to begin on February 1st, 1939, for the purpose of revising the Lucerne Plan and redistributing wavelengths. It is to be held in Switzerland, and the U.I.R. have been commissioned with the formidable task of preparing a suggested new waveplan to be put before the Conference.

This re-allocation of wavelengths is necessitated by the addition of some fifty extra channels on the short-waves and about six on the medium-wave band. The list of additional channels has not yet been published, but according to our Cairo correspondent those on the medium-wave band will be brought about by lowering the bottom end to below 200 metres, *i.e.*, 1,560 kilocycles.

On the short waves the proposed allocations will be:—

6,000-6,200 kc/s	additional 50 kc/s
*7,200-7,300 ,,	,, 100 ,,
9,500-9,700 ,,	,, 100 ,,
11,700-11,900 ,,	unchanged
15,100-15,350 ,,	,,
17,750-17,850 ,,	additional 50 kc/s
21,450-21,750 ,,	,, 200 ,,

* This band will have to be shared with amateurs.

For use in tropical countries three entirely new bands have been suggested, namely, 2,300-2,500 kc/s, 3,300-3,500 kc/s, and 4,700-4,965 kc/s.

All these changes are to be discussed at Ouchy in June as a preliminary to the February, 1939, meeting. The first of a series of conferences convoked by the U.I.R. for the discussion by specialists of tendencies and practices in special departments of programme activity will also be held at Ouchy at the same time.

DEFECTS TO ORDER

Have You Heard the "Faults Box"?

A "FAULTS BOX" is the latest creation of the B.B.C. Research Department at Balham, London, S.W. Into a box no larger than a petrol can has been inserted a collection of apparatus which duplicates every one of the long train of defects in the early days of broadcasting, the idea being to introduce these into dramatic and other programmes in which the radio must not be "too good." For instance, a set working in a Highland crofter's hut of ten years ago should not be expected to give the quality obtainable from a modern radiogram. The "faults box" recreates the deficiencies of the old microphones, amplifiers, lines, transmitters and early horn loud speakers.

The device also creates some interesting aural illusions. It can vary the harmonic content of a voice to give the effect of conversation through a speaking tube, and can produce such queer echoes as those heard in "The Piper" broadcast of ten days ago.

P.A. AT THE EMPIRE EXHIBITION

One Hundred and Seventy Acres to be Covered

THE installation of PA equipment in the main grounds of the Empire Exhibition at Bellahouston Park, Glasgow, is probably the largest of its kind to be used in Great Britain, its output being over 1,000 watts. The equipment, which incorporates 160 loud speakers and twenty microphone points, is being supplied by the G.E.C. Part of this equipment, involving thirty loud speakers and five microphone points, has already been installed in the adjoining Ibrox Stadium, and is completely self-contained.

The 130 loud speakers in the Exhibition grounds will be connected up on five circuits, which can be used independently or a combination employed.

Microphone pre-amplifiers remotely controlled from the main panel, which is housed in a building at the base of the 300ft. observation tower, will be installed in the concert hall, where there will be ten microphones, and in each of the two bandstands, where there will be two microphones.

HOW MUCH WILL THE B.B.C. GET?

THE B.B.C.'s effective share of each ten-shilling licence fee during the financial year ending March 31st, 1939, will be 7s. 9d. under the terms of the Broadcasting Estimate. The Post Office will take 10¾d., the Treasury 11d., and the Corporation 8s. 2¼d. But income tax will amount to roughly 5¼d. of each licence fee, leaving a net share for the B.B.C. of 7s. 9d.

THE WEEK

WORK IN HAND

B.B.C.'s New Stations

A PROGRESS report on the state of new work in hand by the B.B.C. is interesting and opportune. Here is the latest information on this matter:—

Start Point.—The foundations for the transmitter building have been laid and the contractors have begun on the steelwork.

Queen Margaret College, Glasgow.—Work is progressing satisfactorily and the studios should come into operation in May with the exception of the large studio, which will not be finished until the autumn.

Aberdeen Transmitter.—The mast has been completed and the installation of plant has begun. It is hoped to bring the transmitter into operation during this summer.

Aberdeen Studios, Beechgrove House.—Reconditioning of the interior of the building is in hand and work has begun on the extension, which will include the main studio.

Clevedon.—The contract for the building has been placed.

NEW HOLLYWOOD BROADCASTING HOUSE

THE master control room in the recently completed Columbia Square building of the Columbia Broadcasting System at Hollywood is visible to the public through shadowless double glass windows. Sound waves emanating from the studios are shown to visitors on oscillographs, and electric signs indicate the sections of the network to which the programme is being sent.

Each of the studios in the new building is entirely independent in equipment, power and lighting. Each has a series of microphone pre-amplifiers and monitor amplifiers which are strong enough to send the signals directly through to the transmitter instead of being passed through the master control amplifiers. It is understood, however, that the primary purpose of this high-level transmission is the elimination of noises due to low-level lines.

BROADCASTING AND THE PLEBISCITE

DURING last week-end the programmes from the German stations were subject to last-minute changes because of the Plebiscite. The stations broadcast uninterruptedly for over thirty-six hours during Sunday and Monday. The scheduled programmes were recorded to enable them to be used when required. We understand, however, that no indication was given as to whether the items were original or recordings. Most radio plays are now given from records in Berlin as it has been found easier thereby to obtain the services of first-class artistes. Here, again, no indication is given that the plays are recorded.

DERBY TO BE TELEVISED

AS a result of consultations between officials of the B.B.C. and the Epsom Grand Stand Association, the latter has lifted the ban which it imposed on television, and the Derby will now be seen by viewers. Three cameras will be used, the one in the Grand Stand being fitted with a six-inch lens.

THE CANADIAN MARCONI CO.

MR. EDWARD WILSHAW, Chairman of Cable and Wireless, Limited, to whom was referred the announcement made by Mr. Sarnoff, President of R.C.A., at the annual meeting, corrects the impression conveyed in Mr. Sarnoff's announcement. He points out that the R.C.A. were not direct owners of shares in the Canadian Marconi Company, but held 11,500 "B" (non-voting) shares in Canmar Investment Company, and it is these which have now been purchased by Cable and Wireless, Limited, from the R.C.A.

In addition to this holding of "B" stock in Canmar Investment Company, Cable and Wireless have recently acquired 2,500 "A" (voting) shares of that company previously held by Messrs. Lazard Brothers and their associates, thereby obtaining the voting control of the Canadian Marconi Company.

The control of the Canadian Marconi Company has always been in British hands; the transaction recently entered into consolidates that control in the hands of the British Communications Company.

GERMANY'S LIP MICROPHONE, like its English equivalent, cuts out all extraneous noises, but is highly sensitive to words spoken at very close range. It is used extensively for relays from political meetings and sports contests.

BROADCASTING IN IRELAND

IT has been announced by the Irish Minister for Posts and Telegraphs that the wavelength to be used by the experimental 1.5 kW short-wave transmitter, which is being installed at Athlone, will be fixed at the Cairo Telecommunications Conference. The station should be operating by the end of the year.

The number of wireless licences in force in Ireland at the end of February was 139,534, an increase of 36,214 over the previous year. The annual revenue from licences amounts to approximately £70,000, and advertising yields about £35,000.

UNCLE MAC INJURED

ALTHOUGH Mr. Derek McCulloch has been associated with the Children's Hour since he joined the B.B.C. over twelve years ago, he is very well known to listeners of all ages, and it must have been with regret that it was learned of his injuries received in a motor-coach accident last Friday, which has resulted in the amputation of his left foot. It was only a day or two before that he had been appointed Director of the Children's Hour. He has had many years of suffering since the Great War, in which he served in the R.F.C., being severely wounded and losing the sight of his right eye.

TELEVISED NEWSREELS

COMPLAINTS by members of the Cinema Exhibitors' Association concerning the granting of television rights in newsreels to the B.B.C. were recently put before the chiefs of newsreel companies.

According to *The Cinema* there was general agreement that the showing of televised newsreels in public-houses, etc., was inimical to the interests of the trade, and that the same condition might be placed upon television newsreels as is placed upon the broadcasting of news by the B.B.C.

FROM ALL QUARTERS

Television at I.E.E.

AT the ordinary meeting of the Institution of Electrical Engineers to be held at Savoy Place, London, W.C.2, on Thursday next, April 21st, at 6 p.m., two papers on television will be read. One is on "The London Television Service" by T. C. Macnamara and D. C. Birkenshaw, M.A., and the other on "The Marconi-E.M.I. Television System" by A. D. Blumlein, C. O. Brown, N. E. Davis and E. Green, M.Sc.

Eiffel Tower Television

THE Eiffel Tower television transmitter, which has been radiating regular experimental transmissions on reduced power since September, 1937, was officially inaugurated by the Minister of Posts and Telegraphs last Friday. It is shortly to utilise its maximum output of 30 kilowatts.

Confiscated Radio Station

RADIO ALDERNEY, LTD., and its managing director, were found guilty by the Guernsey Royal Court in the action brought against them by the P.M.G. for illegally operating a broadcast station. The company was fined £10 and costs, its plant ordered to be confiscated and handed over to the P.M.G. and the managing director was fined £5.

Radio Intermediary

EACH of America's privately owned wireless stations has to renew its licence through the Federal Communications Commission every six months. The National Association of Broadcasters, which consists of officials of 425 stations, has appointed a public relations councillor to act as a temporary intermediary, who would endeavour to smooth out any difficulties which might lie in the way of licence renewal.

American Radio Comes to Scotland

THE President of the American station, WHB, has organised a trip to Europe for station directors. The trip, which will begin on July 15th, includes a visit to the Empire Exhibition at Glasgow, where an official reception will be given by B.B.C. representatives.

Australian War Memorial Broadcast

AUSTRALIA is arranging for a nation-wide relay of the unveiling ceremony by the King of the Australian War Memorial at Villers Bretonneux in June. The B.B.C. will relay the broadcast to London, and also transmit recordings from Daventry on varying wavelengths throughout the day.

Television at 110 Miles

TELEVISION from Alexandra Palace is being well received in King's Lynn, Norfolk, by Mr. C. J. Baynes, a radio engineer. Mr. C. J. Gardner, of West Southbourne, Bournemouth, is receiving excellent pictures on an experimental receiver, built by himself.

Miscellaneous Advertisements and April 21st issue

ADVERTISERS are reminded that owing to Easter and the slight alteration in our printing arrangements for April 21st issue, it was necessary to close the miscellaneous advertisement pages for press earlier than usual. No more copy can now be accepted for that number.

New Time Base

A HARD-VALVE CIRCUIT WITH LINEAR CHARACTERISTICS

By D. G. REID, B.Sc., A.C.G.I.

DESCRIBING a modification of the original "squegging" oscillator which is applicable to television receivers and cathode-ray oscillographs, etc.

THE generation of voltages or currents having "saw-tooth" waveforms for the electrostatic or electromagnetic deflection of the beam in a cathode-ray tube has always been a subject of interest in oscillographic work, and its importance has increased of late with the wide application of the tube to television purposes.

The chief requirements of generators for this purpose may be summarised as follows:

Linearity over the whole of the "forward" stroke.

Rapidity of "return" stroke.

Positive synchronisation with relatively small input voltages, preferably without the consumption of power from this source.

Economy in supply voltages and the number of valves used.

A large number of different forms of such generators, or "time-base" circuits, have been devised, most of which employ the principle of charging (or discharging) a condenser at a constant rate through a high resistance or a saturated valve, and periodically discharging (or charging) it by means of a gas-filled discharge tube or a combination of one or more hard valves so connected as to be equivalent thereto.

In spite of the acknowledged simplicity of the gas-discharge tube type of circuit, there are certain advantages in the use of hard valves to perform what may be called the switching function, i.e., the periodic charging or discharging. Time-lag effects due to the finite de-ionisation time are absent, and the circuit is not sensitive to temperature fluctuations due to draughts, etc., as is a gas discharge tube. Also, the average life of a hard tube is generally greater than that of a gas-filled one, due to the absence of positive ion bombardment of the cathode.

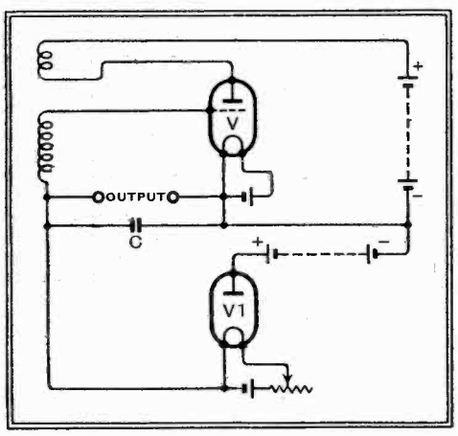


Fig. 1.—The original "squegging oscillator" circuit.

The circuit described below, which was developed in the Communications Laboratories of the City and Guilds Engineering College, differs from previous hard-valve circuits only in the manner in which a single valve is made to perform the switching function—in this case charging the condenser. Its operation can probably best be understood by comparison with that of its logical prototype, the so-called "squegging" oscillator. This circuit, shown in Fig. 1, was developed by Watson-Watt, Appleton, and Herd for the Radio Research Board, and was one of the earliest time-base circuits. Here the triode valve V is connected as an ordinary oscillator, the circuit constants being such as to produce a very high frequency of oscillation in comparison with that of the saw-toothed output voltage required. The grid condenser C, instead of being shunted by the conventional leak resistance, has in parallel with it a tungsten-filament diode V1, the filament of which is sufficiently under-run to ensure that its total emission current is considerably less than the normal grid current of the triode V when the latter is in the oscillating condition. The battery connected in series with V1 maintains the current through this valve continuously at the saturation value.

When the valve V commences to oscillate, the excess grid current which cannot flow through V1 flows into C, causing an increase in the mean negative bias of V until oscillation can no longer be maintained, and the flow of grid current abruptly ceases. C now discharges through V1 at a constant rate until a point is reached where oscillation starts again and the cycle is repeated.

It is seen that the operation of this circuit depends on "backlash" in the oscillator, i.e., on oscillation being maintained with a larger negative grid bias than will allow its inception. This condition can readily be obtained by the use of sufficiently tight coupling, but the extent of the backlash is small in comparison with the anode supply voltage, so that the circuit is not very efficient from the point of view of output voltage, which is taken from the condenser C. The range of frequencies obtainable extends from the very lowest up to two or three megacycles per second, when C is merely the inter-electrode and stray capacities associated with V1.

In the new arrangement to be described the fundamental circuit is modified to that shown in Fig. 2, in which the condenser C is in series with the cathode lead of the valve V, so that the anode current, rather than the grid current, causes the blocking of the grid. This is an advantage, since grid current is very dependent on the material and temperature of the grid, due to the effects of secondary emission.

The discharge device shown here is the usual pentode arranged to operate beyond the "knee" of its characteristic, although, as will be seen later, this can advantageously be replaced by a high resistance.

The operation of this circuit may be described as follows: Assume the condenser C to be initially charged to such a voltage that the grid of V is sufficiently negative to prevent the passage of anode current. The discharge valve V1 draws a constant current from the condenser, the voltage of which falls accordingly. This causes a fall in the negative grid bias, accompanied by a rise in the potential of the anode with respect to the cathode of V, since the voltage across the condenser is in opposition to the high-tension supply voltage. Eventually the cut-off point is reached when current starts to flow through the charging valve. This current, flowing through the condenser in the opposite direction to that taken by the discharge valve, tends to increase the negative potential of the grid of V, but this tendency is opposed and temporarily overcome (if the coupling between L1 and L2 is in the right sense and of sufficient magnitude) by the voltage which the in-

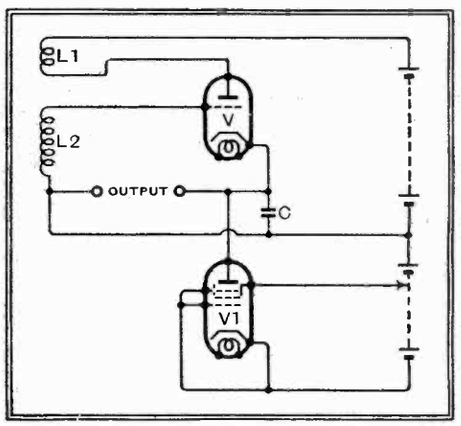


Fig. 2.—The new circuit in its fundamental form.

New Time Base—

creasing current in L1 induces in L2. Eventually, however, due to the anode current reaching the saturation value, or to the condenser voltage becoming so high that there is no longer sufficient anode-to-cathode voltage available, irrespective of the induced positive grid potential, to allow further increase in anode current the current in L1 becomes stationary. Immediately this happens the induced voltage in L2 disappears, and the grid potential reverts to that of the terminal of the condenser remote from the cathode, i.e., it becomes very negative thereto.

The anode current through L1 now starts to decrease, thereby inducing a voltage in L2 driving the grid still more negative. The current through the charging valve is thus cut off with extreme rapidity, limited only by the self-capacity of the inductance coils and the inter-electrode capacity of the valve. The condenser is thus left with a large accumulated charge, since the current passed by the charging valve during its brief conducting period is many times greater than that drawn by the discharge valve. This charge now drains away through the discharge valve, until the potential across the condenser again reaches the cut-off point, when the cycle starts again.

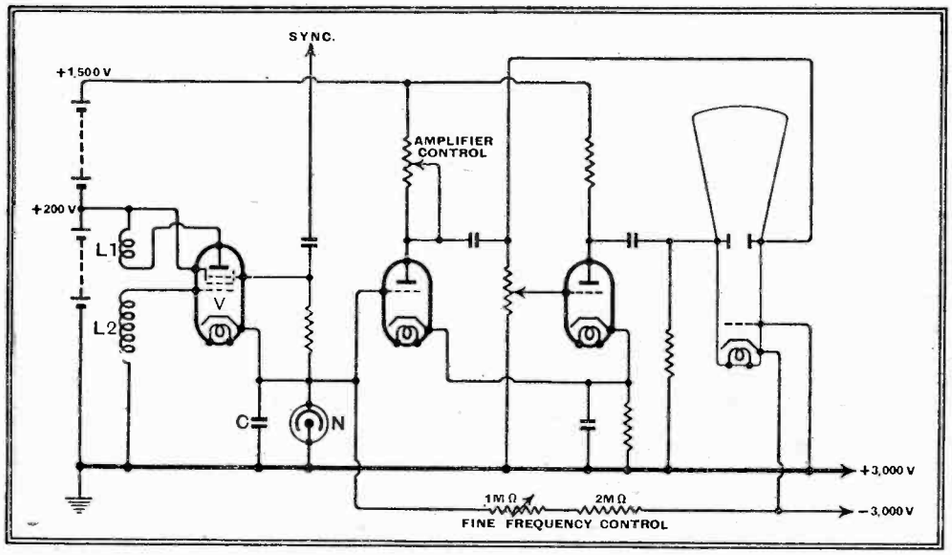


Fig. 3.—Modification of the new circuit, with pentode oscillator and discharging resistance.

Increasing Flyback Speed

Although the cutting-off action of this circuit is extremely rapid, the fact that the whole of the charging current has to flow through the inductance L1 limits the rapidity of the charging action and thus slows down the flyback. This objection is overcome by replacing the triode with a pentode as a charging valve, the screen or auxiliary electrode being taken direct to the positive terminal of the high-tension supply. A fairly large fraction of the charging current then flows straight through the auxiliary electrode circuit to the cathode, the remainder flowing through the main anode circuit *via* the inductance being sufficient (with a suitable valve, such as a VMP4G) to induce the requisite voltages in the grid circuit. A distinct improvement in the speed of the flyback is obtained by this means, and in addition the suppressor grid of such a pentode provides a convenient point for the injection of the synchronising voltage.

The high rate of change of current in L1 may be made use of to extinguish the beam during the return stroke, by inductively coupling L1 to a small coil connected in series with the control grid of the cathode-ray tube.

The mere substitution of a resistance for the discharge valve in Fig. 2 gives rise to exponential distortion of the waveform during the forward stroke, unless a very high voltage supply is connected in series with the resistance. This is because the percentage variation in the forward velocity is the same as the percentage variation of the voltage across the resistance. It so happens, however, that in most cases where the circuit will be used such a high voltage source is available, namely, the supply voltage to the "gun" or filament end of the cathode-ray tube. Especially in cases where subsequent amplification is used, as for obtaining a balanced push-pull output, the sweep of voltage across the condenser need only be of the order of 50 volts, so that with 3,000 volts on the "gun" the linearity is within 2 per cent. A complete circuit diagram embodying this arrangement, together with the fast flyback pentode circuit, is shown in Fig. 3, and Fig. 4 shows the output waveform obtainable.

It will be seen in Fig. 3 that the amplifier is directly coupled to the time-base circuit, the usual coupling condenser and leak being omitted, as the latter would have to have an impracticably high value to avoid exponential distortion.

A small neon discharge tube N is shown connected across the condenser C. The object of this is to prevent a dangerously high voltage being developed across the condenser, and between the cathode and heater circuit of the charging valve, in the event of the high voltage supply to the cathode-ray tube being switched on before the valves in the time base have had time to heat up, or if the heater voltage fails for any reason. Such neon tubes are available at a cost of a few shillings, and withstand a voltage of approximately 160 before striking. As the normal range of voltage across C is considerably less than this, the presence of the neon tube has no effect on the normal operation of the circuit.

Coil Windings

The values of the inductance coils L1 and L2 are not at all critical, although for the fastest flyback they should be kept as small as possible. Ordinary honeycomb-type coils, tightly coupled, have been found to give good results, the values of the anode and grid circuit coils being about 120 and 200 microhenries respectively. These inductance values are substantially independent of the operating frequency, and are suitable for the whole range of frequencies over which the circuit will work, namely, from a few cycles up to about two hundred kilocycles per second.

The value of the condenser C directly controls the operating frequency, and since it is in parallel with the cathode-to-heater capacity of the charging valve, and with the grid-to-cathode capacity of the first amplifier, it is these latter which set an upper limit to the operating frequency.

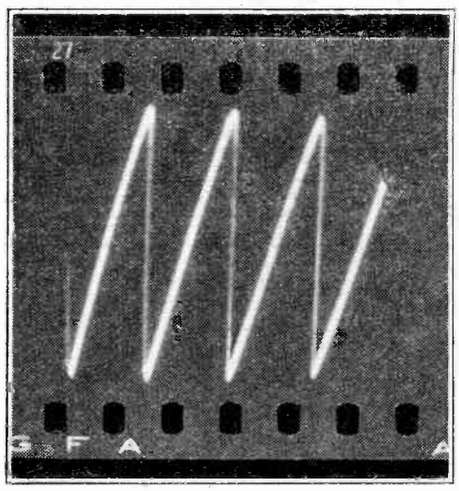


Fig. 4.—Waveform obtained from the circuit of Fig. 3 (frequency 3,300 c/s).

For satisfactory synchronisation the "natural" or unsynchronised frequency should be approximately that of the synchronising voltage. It is theoretically best to adjust this frequency entirely by variation of C, but as this is inconvenient, especially at low frequencies, when C is large, fine adjustment of frequency is made by variation of the discharge resistance over a relatively small range, say, from two to three megohms.

For the framing frequency (50 cycles) C should be about 0.5 mfd., and for the

New Time Base—

line frequency (10 kilocycles) about 0.002 mfd. These values are applicable where the gun voltage is 3,000, the discharge resistance 3 megohms, and the voltage swing on the grid of the first amplifier valve is 40. For values other than these C would have to be modified proportionately.

Amplitude control is best carried out in the amplifier circuit, so as to avoid alteration of the mean grid potential of the first amplifier valve. Coarse adjustment, to obtain the right order of swing on the amplifier valves, is effected by adjusting the high-tension voltage supply to the charging valve (i.e., the 200-volt supply shown in Fig. 3), while the output amplitude is controlled by a potentiometer in the anode circuit of the first valve in the paraphase amplifier. It is found that, provided the settings of the coupling coils are left unchanged, control of frequency by either C or the discharge resistance has practically no effect on the amplitude of the output voltage.

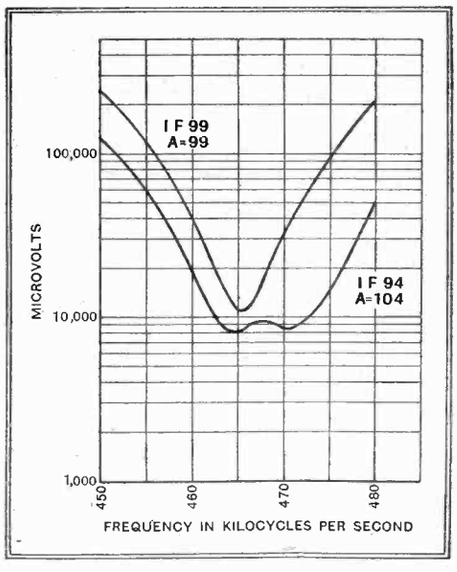
New Apparatus Reviewed

Recent Products of the Manufacturers

WEARITE IF TRANSFORMERS

A RANGE of IF transformers has been introduced by Wright and Weaire, Ltd., of 740, High Road, Tottenham, London, N.17. The types with iron-cored coils can be obtained for an intermediate frequency of 110 kc/s (IF96) or 465 kc/s (IF94), and they are priced at 6s. 6d. each. The coils are included with their trimming condensers in an aluminium can for bolting to the chassis. The four connections are normally soldering tags at the bottom of the can, but the transformers can be obtained with the grid or anode lead brought out at the top for 3d. extra.

Tested with a W42 valve a gain of 104 times was secured with the transformer loaded by the valve voltmeter only. Under these conditions the circuits are slightly over-coupled, giving the double-humped resonance curve shown. The peak separation is 5 kc/s, and the useful band-width 14 kc/s for a drop in response of 3 db. at the edges of the pass-band.



Resonance curves of the Wearite IF94 and IF99 transformers.

The Type IF99 transformers are supplied without a screening can, and have air-cored coils; they are priced at 4s., and tested under the same conditions as the IF94 the curve shown was obtained. The stage gain is 99, and the band-width for a 3 db. drop is 4 kc/s.

TUNGSRAM RECTIFIER

A NEW rectifier, designed for use in car radio sets, is announced by Tungsram. It is a full-wave, indirectly heated type taking 0.65 amp. at 6.3 volts. The HT rating is 400-0-400 volts at 100 mA. When used with a vibrator it is recommended that a 250-ohm resistance be inserted in the lead to the transformer centre-tap.

The valve is fitted with a standard British 5-pin base, the centre-pin of which is used for the cathode.

E.T.L. VALVE TESTER

A VALVE tester designed for operation from AC mains has been submitted for test by the Electrical Test Laboratories, Ltd., 189, Regent Street, London, W.1.

The valve under test has its grids and anodes strapped together. An alternating voltage is applied between these electrodes and the cathode, and the resulting rectified current is read on a milliammeter. This carries two coloured sections marked "Good" and "Bad."

The reading of the meter depends on the condition of the valve and upon the setting of a calibrated variable resistance. In use the setting of this resistance for the particular valve under test is looked up in the chart provided and on pressing a safety switch the meter indicates the condition of the valve. On test the instrument gave a clear indication between good and bad valves. Twenty valve-holders are provided for British and American valves, and two blank holes are provided for the addition of new valve-holders should these be necessary in the future. Sockets are provided for the connection of phones, so that a noisy valve can be picked out.

A neon tube is included for testing for short circuits between electrodes, including heater and cathode, and the meter can be used for external voltage measurements with ranges of 10, 250 and 500 volts at 1,000 ohms per volt.

Fuses are included for protection, and the whole apparatus is in a black leatherette case weighing 11 lb. 12 oz. Its dimensions are 15⅝in. by 13¾in. by 15⅝in. It is priced at 11 guineas.

Club News

Eastbourne and District Radio Society

Headquarters: The Science Room, Cavendish Senior School, Eastbourne.
Hon. Sec.: Mr. J. P. Glickman, "Kersal," Brodrick Road, Hampden Park, Eastbourne.

At the last meeting of the Society two members brought transmitting apparatus and demonstrated how oscillation could be indicated by means of a turn of wire and a fuse bulb.

On April 25th a lecture will be given by a Belling-Lee representative.

Chadwell Heath and District Amateur Radio Society

Headquarters: Ralph's Café, Trolley Bus Terminus.
Hon. Sec.: Mr. R. C. E. Beardow, 3, Geneva Gardens, Chadwell Heath, Essex.

At the meeting on March 29th morse practice was held from 8.30 p.m. to 9.15 p.m. After a short interval G8PL gave a talk entitled, "Weather Conditions as Affecting Radio."

London Transmitting Society

Headquarters: 40, Raeburn Road, Edgware.
Meetings: Thursdays at 8 p.m.
Hon. Sec.: Mr. G. Yale, 40, Raeburn Road, Edgware.

A monthly bulletin entitled L.T.S. has been started by the society. It is circulated privately to members.

Wirral Amateur Transmitting and Short-wave Club

Headquarters: Beechcroft Settlement, Whetstone Lane, Birkenhead.
Meetings: Last Wednesday in the month at 7.30 p.m.
Hon. Sec.: Mr. J. R. Williamson, 13, Harrow Grove, Bromborough, Birkenhead.

The annual meeting was held on March 30th, when the chairman announced that there had been an increase of thirteen in the membership during the year, bringing the total to 34. The club has now a dozen fully licensed transmitters and six members with artificial aerial licences.

It was decided to continue with the monthly meetings and to have a field day during the summer.

Croydon Radio Society

Headquarters: St. Peter's Hall, Ledbury Road, South Croydon.
Meetings: Tuesdays at 8 p.m.
Hon. Pub. Sec.: Mr. E. L. Cumbers, 14, Campden Road, South Croydon.

At the recent annual general meeting it was reported that since Christmas the average attendance had reached a figure never attained before. Discussing future programmes, it was decided that those dealing with quality reproduction should be increased to 75 per cent. of the whole. In the ten-minute talks one member showed a home-made cinematograph film, and another demonstrated his two-stage amplifier.

The E.T.L. valve tester.

UNBIASED

By FREE GRID

High-pressure Salesmanship

ALTHOUGH I always endeavour to take a kindly view of the shortcomings of my fellow-men, there are times, I fear, when my faith in human nature seems on the point of failing. No doubt some of you have felt the same sort of thing at some time in your lives. I well recollect an Australian friend of mine telling me of the romantic ideas he used to entertain concerning the rural beauty of England, about which he had been told by relatives in the Old Country whose imagination was apt to run away with their sense of veracity. Eventually the time came when he was invited to make a prolonged stay with his relations in Manchester, and he told me that he would never forget his bitter disappointment as he sailed up the Manchester Ship Canal one dreary November afternoon, and his thoughts immediately flew back to the sunny warmth of Sydney's aquatic glory, to be followed shortly afterwards by himself.

I am moved to these melancholy reflections by some revelations which a friend recently brought to my attention concerning certain features of American high-pressure salesmanship which had come his way, and in connection with which he sought my aid. It appears that quite recently he and his neighbours were startled by some truly devastating electrical interference which made the reception of broadcasting almost impossible. A few days later my friend received a call from a high-pressure American salesman who practically forced his way into

So this is England.

the house and insisted on demonstrating an anti-static aerial and a mains filter, both of transatlantic origin.

To give the devil his due, my friend admitted that these gadgets were remarkably efficient in getting rid of the trouble, and the salesman had no difficulty in disposing of the whole stock in the neighbourhood. He would not have thought much about this, however, had he not heard of a similar chain of circumstances occurring in a neighbouring district.

His suspicions were aroused, and eventually he consulted me upon the matter. Fortunately I have quite a considerable knowledge of detective technique which I picked up when with the police in my younger days, and I soon found one or two valuable clues. Eventually I discovered that this cycle of affairs had been repeated in a large number of districts, and in each case it had been marked by the significant fact that the salesman and an assistant had both taken rooms in the district a few days before the interference broke out.

After this discovery I was not long in running my quarry to earth and exacting a full confession. It appears that they had been working an old dodge known as "creating a demand." This is quite common in America, but is happily rare in this country. While the salesman went on his rounds his assistant was busy manufacturing interference in their lodgings by means of simple electro-therapeutic apparatus of the so-called violet-ray type. Unfortunately there is no question of reporting them to the police, as in the present state of the law over here their action is perfectly legal.

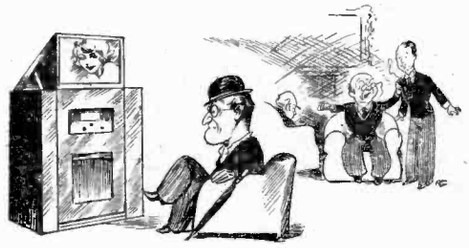
A Sun-bathing Dilemma

I SUPPOSE that most of you are aware that special television receivers are now available for clubs and such-like places where a large number of people wish to look in at the same time. For this purpose the image from a small cathode-ray tube is passed through an optical magnifying system and projected on to a ground-glass screen. As in the case of a photographic enlargement, the picture has to be viewed from a little distance away if it is to compare in quality with that of the domestic model, and for this reason is not likely to oust the latter from its position in the home.

I must confess that I viewed the coming of this projection model with extreme favour because of certain urgent private reasons. As I told you some time ago, the screen of the cathode-ray tube used in certain domestic receivers is extremely rich in ultra-violet radiation, and for this purpose I had hoped to use the B.B.C. television programmes all through the past winter as much for sun-bathing purposes as for the entertainment they give. Unfortunately, viewing the B.B.C.'s television programmes became very popular with Mrs. Free Grid and her friends, and she has been giving a series of Television Teas at which there is usually foregathered as motley a collection of females as it has ever been my fortune to see in a somewhat long and varied career.

Now I have no rooted objection to the opposite sex; taken in small doses they can be very agreeable indeed, like arsenic, for instance. But, as in the case of the mineral substance mentioned, they become quite intolerable in the mass. I would, however, in my eagerness to see the B.B.C.'s television programmes, have put up even with these Television Teas, but for one very grave disadvantage, namely, the obvious necessity of restricting my sun-bathing activities. Since the "club" type of television receiver appeared, therefore, I have been repairing every afternoon to my club in Pall Mall to enjoy my daily dose of sunshine in comfort and security.

Unfortunately, however, in spite of all this, the degree of sunburn on my person has been steadily decreasing, and I should still be at a loss to account for it had not a well-known physicist who had been dozing all the winter before the fire in the Club suddenly woken up one afternoon and noticed my collarless state. He immediately summoned an attendant and made a formal complaint to the Secretary, who explained the position to him, upon which he was fortunately able to diagnose the cause of my trouble.

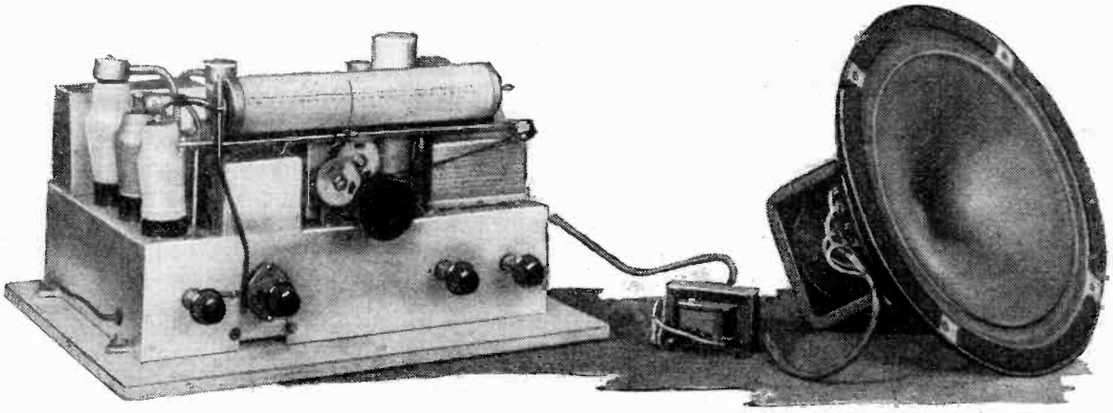


A complaint to the Secretary.

The small cathode-ray tube, it appears, emits its full quota of ultra-violet rays, but owing to the fact that a mirror is employed to reflect the picture on to the screen, this radiation becomes very greatly attenuated. It looks very much, therefore, as if I am faced with the alternative of giving up my synthetic sun-bathing altogether or throwing down the gauntlet to the assembled mob at one of Mrs. Free Grid's Television Teas, a prospect which I do not at all relish.

A.R.P.

THANKS to the many readers who have written to tell me that I can obtain a Government grant towards the building of the underground loud speaker which I recently described, as it can be used as a communal air raid shelter. Several correspondents tell me that they intend to combine business with pleasure by building one of these loud speakers, and have written to the Government for the necessary subsidy before they commence operations.



Eddysto

FEATURES. ***Waveranges.*** *—(1) 12.95-34.9 metres. (2) 31.98-85 metres. (3) 205-550 metres. (4) 900-2,000 metres.* ***Circuit.*** *—Pentode RF amplifier —hexode mixer—pentode oscillator — pentode IF amplifier (465 kc/s)—double diode triode second detector —pentode output valve. Full-wave valve rectifier.* ***Controls.*** *— (1) Tuning. (2) Volume. (3) Tone. (4) Waverange. (5) On-off Switch.* ***Price.*** *—(Chassis, valves and loud speaker) 21 guineas.* ***Makers.*** *—Stratton & Co., Ltd., Bromsgrove Street, Birmingham, 5.*

AN EFFICIENT ALL-WAVE RECEIVER OF RUGGED CONSTRUCTION

THE experience of this firm in catering for tropical markets is of long standing and their preference for solid cast chassis and coil screens is well known. From the point of view of durability the advantages of this form of construction are obvious, but in temperate climes the justification for the additional cost must be sought in the improvements which it confers on the overall performance.

Stability is the keynote of the whole design; frequency stability contributed to by the rigidity of coil mountings, and stability from the point of view of uniform amplification resulting from the elimination of unwanted feed back by the efficiency of screening.

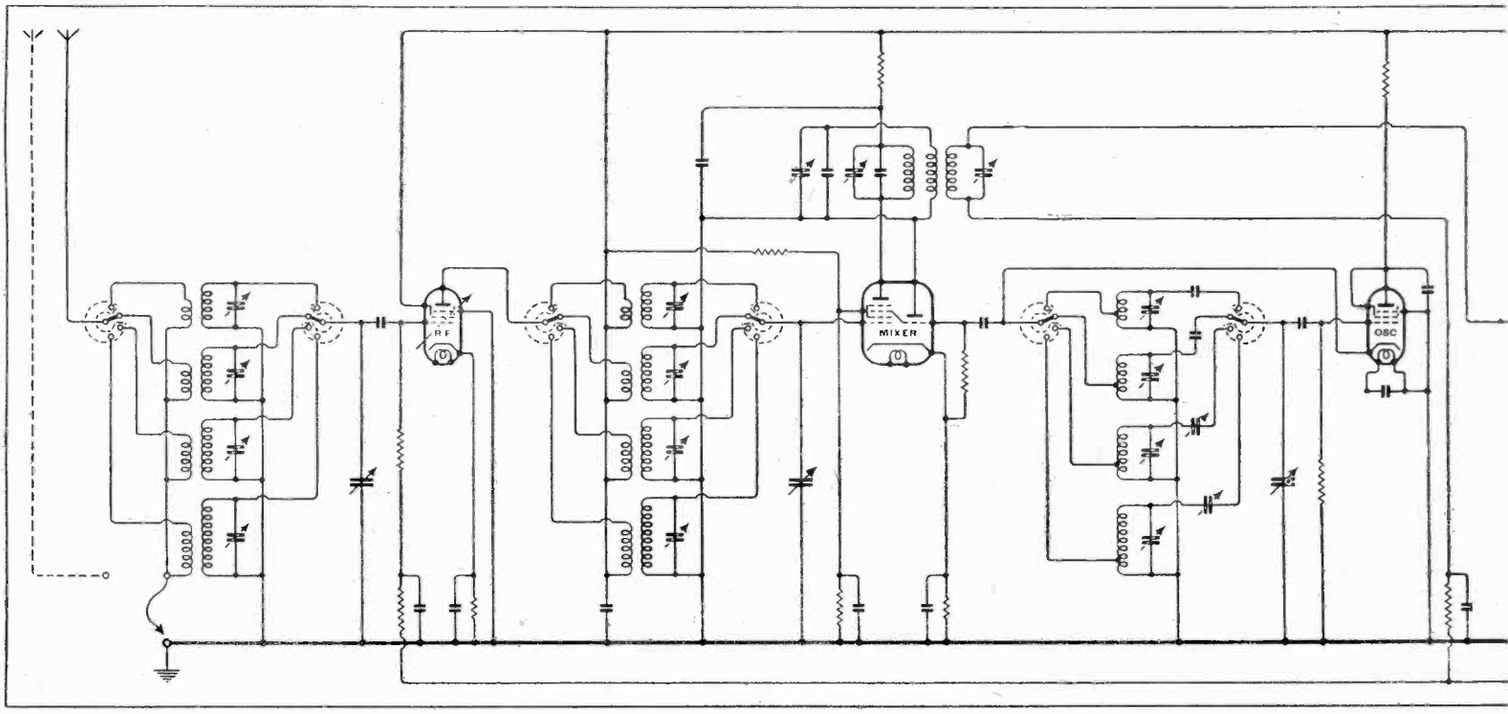
Air dielectric trimmers are used in the three-circuit IF band pass filters and a separate oscillator is used on a circuit designed to give the minimum of frequency drift. The frequency changer is a triode-hexode in which the hexode portion alone is used for mixing. An RF amplifier tuned on each of the four wavebands precedes this stage and is controlled with the IF amplifier by AVC, in which the conditions of operation have been chosen primarily to suit the short-wave ranges.

That this claim is not without good foundation was proved when the set was inadvertently operated on the lowest waveband with only the short connecting lead projecting from the side of the chassis as an aerial. Incidentally, twin leads are provided here for a doublet aerial, one of these being joined to the earth terminal at the back when a single wire aerial is used. When the outdoor aerial was connected the signal strength of an American station which had been tuned in without any difficulty on the short aerial lead rose by only a few db. A more remarkable feature of this unrehearsed incident was that the signal-to-noise ratio gave no clue to the fact that the aerial was off, neither was sensitivity obviously deficient by the standard of performance which is expected of a normal all-wave broadcast set. Many sets of outstanding performance from the point of view of overall magnification seem to show an avidity for any and every type of impulse picked by the aerial, but the E.R.A.7's best response is undoubtedly reserved for carriers and other CW transmissions.

Second channel interference is negligible, and under the conditions of test, with the loud speaker mounted on a separate baffle, microphony was entirely absent even at full magnification on the strongest carriers.

Sensitivity is well maintained down to 13 metres, and an unusually good performance was given on the 13.8-metre broadcast band relative to the 16- and 19-metre groups. The scale is pro-

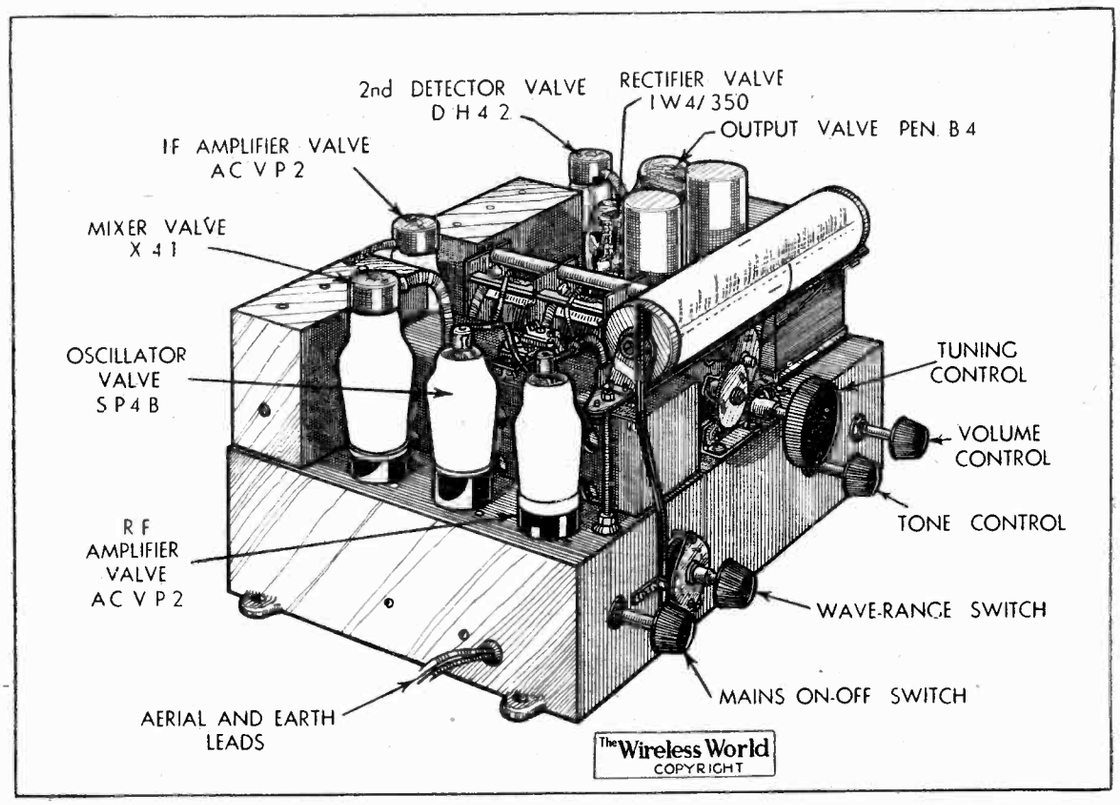
Complete circuit diagram. The use of the hexode portion of a triode hexode valve as mixer in conjunction with a separate oscillator is the principal deviation from standard practice.



E.R.A.7

vided with subsidiary graduations on all broadcast and amateur bands to facilitate logging of stations, and the slow motion obtained when the direction of rotation of the tuning knob is reversed conveniently covers each of these bands.

Calibrations are in megacycles and metres on the two short-wave ranges, and in metres and station names on medium and long waves. Each scale is 10 inches long and is brought into view automatically by a rack and pinion mechanism coupled to the waverange control. Mechanically the arrangement works smoothly and the change over from one waveband to another is electrically silent—an important point in a receiver with high overall magnification.

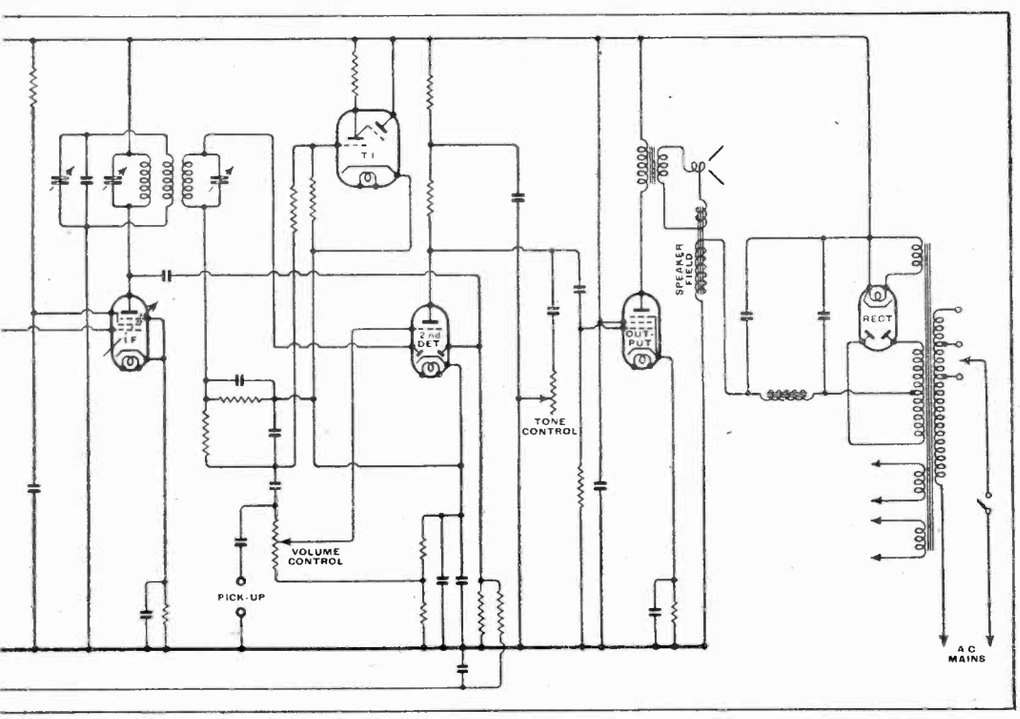


Aluminium alloy castings are used for the IF and signal frequency tuned circuits as well as for the main chassis. The rotary tuning scale drum is actuated through a rack and pinion mechanism by the waverange control.

Uniformity of sensitivity is as much a quality of the ordinary broadcast wavebands as it is of the short waves, and the signal-to-noise ratio is very much better than usual below 250 metres. Not a single self-generated whistle could be traced anywhere, and the selectivity on medium waves was sufficient to give a clearance from the modulation of London Regional well within one channel on either side of its normal setting at a distance of 15 miles. On long waves the Deutschlandsender is easily received clear of its neighbours and at excellent programme strength.

The high selectivity does not appear to have affected adversely the quality of reproduction. There is no apparent deficiency of top and the treble response is quite free from harshness. This is not one of those sets where the tone control is an essential element in the ultimate achievement of good balance, and its function is confined to the mitigation of background noise under poor conditions of reception on short waves.

The energised loud speaker supplied with the set is of massive construction and makes use of a 12-inch curved sided diaphragm. The speech coil diameter is above the average, and in spite of a fairly tight surround there is no lack of bass response. Frequency doubling is not obvious, and judging from the output power the rating of the final stage (5 watts) is not merely a catalogue figure.



Sound Construction

Workmanship underneath the chassis is in keeping with the clean exterior. Ceramic valve bases are employed, and porcelain is also used for wiring anchorages at many points.

This is an instrument which cannot fail to catch the eye of the experienced wireless enthusiast. He will find the performance no less attractive, for the makers have mopped up all the minor troubles which often accompany high magnification and selectivity in a superheterodyne circuit. Furthermore, the quality of reproduction makes it an excellent receiver for the general use of the household.

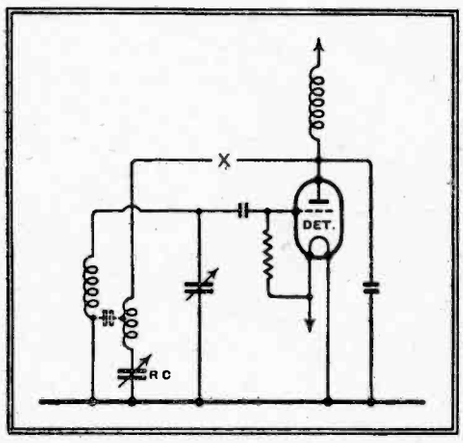
Cabinet work is more or less left to the purchaser, but a solidly built and attractive-looking console is obtainable to order through the manufacturers.

Readers' Problems

A Selection of Queries dealt with by the Information Bureau, and chosen for their more general interest, is published on this page.

Location of Reaction Condenser

A READER wishes to know which is the correct position for a reaction condenser, between the detector valve anode and the coil, or at the "earthy" end of the coil, as he has seen this condenser some-



In a broadcast set reaction is usually better under control when the condenser is joined at X instead of as shown here.

times in the one and sometimes in the other position.

Theoretically the correct place in the circuit for this condenser is at the "earthy" end of the reaction winding, so that its moving vanes can be earthed and thereby avoid the disturbing effects of hand capacity.

Unfortunately, this is not always satisfactory in the case of ordinary broadcast sets, as even with the reaction condenser at minimum, or even disconnected entirely, the detector circuit cannot be prevented from oscillating, and it can only be stopped by disconnecting the reaction winding from the anode of the valve.

This state of affairs is brought about by the existence of a capacity shown dotted in the figure between the reaction and the tuned windings. As this capacity is in parallel with RC it will, if large enough, maintain the circuit in oscillation even with RC at minimum, RC not then taking full control.

If, now, RC is changed over to the point X, the inter-coil capacity is no longer in parallel with it, and the amount of regeneration feed-back will then be determined solely by the capacity of RC.

As both moving and fixed vanes of the reaction condenser will be "live" to RF, it will have to be removed from the front panel and controlled by an insulated extension rod.

In short-wave sets RC can usually be joined in the "earthy" end of the reaction circuit, since the inter-coil capacity is too small to be troublesome in this respect.

Size of Loud Speaker Baffle

ADVICE is required regarding the correct size of baffle for a loud speaker having an 8in. diameter diaphragm in order to obtain the best possible reproduction.

Actually, there is no definite limit to the size of a baffle, as a loud speaker let into the partition wall between two rooms would probably give the best results in the circumstances.

As this plan is not always convenient, the next best would be a baffle of irregular shape and not less than 6ft. by 4ft. overall, and with the loud speaker mounted slightly off centre.

This conclusion was reached after tests had been made with baffles of different size and shape, the loud speaker response being illustrated by curves taken at the time. These were published in *The Wireless World* of May 22nd, 1936, in the article, "Loud Speaker Baffles."

Power Output

THE reason why it is so often stated in *The Wireless World* that an output of four to six watts is necessary in order to obtain the highest standard of reproduction has been the question asked in more than one letter recently. The writers point out that even one watt can be intolerably loud in a room of quite normal size.

This, of course, is quite true, but for ordinary domestic requirements the receiver or amplifier, as the case may be, is never operated at maximum volume. The large output stage is necessary in order to take care of momentary peaks without introducing distortion.

To achieve this the average level of output will have to be comparatively low, and possibly not more than one to one and a half watts. A four-watt amplifier is, therefore, not unduly large for high-fidelity reproduction.

Nomenclature

WHEN the superheterodyne was first evolved, two valves were used for the purpose of frequency-changing; one was described as the local oscillator and the other as the first detector. The detector qualification was adopted, as there was another detector after the IF amplifier, this being designated the second detector.

Even when a single multiple-electrode valve replaced the earlier two-valve arrangement the original designations were often retained, but it is now the customary practice to describe this stage simply as the frequency-changer, whether one or two valves are employed.

The expression "second detector" is now rarely used, this valve being referred to as the detector without further qualifications.

This clarification may be of interest, as it appears that a little confusion still exists in the minds of some readers not fully acquainted with the current practice of identifying the various stages in a modern superheterodyne.

Mains Hum

HAVING modified a mains set and fitted an intervalve transformer where hitherto resistance-capacity coupling was used, a reader is troubled by a very pronounced hum. Actually, the set was not perfectly silent before, but the hum was only just audible. We are asked if there is any explanation for it and how it can be suppressed.

By changing to transformer coupling giving probably a voltage step-up of one to four the AF gain is proportionally greater and any residual hum will, of course, be increased, or at least, that portion that originates in the earlier stages of the set.

We doubt, however, if this would account for a very marked increase in the hum level. It can be tested for by disconnecting the primary and joining across it a resistance of the same order as the AC resistance of the preceding valve. If the hum still persists it is almost certain to be due to direct induction into the transformer from either the mains transformer or smoothing chokes, but most likely by the former.

The AF transformer should be removed from the baseboard, and flex leads of sufficient length to enable it to be turned in all directions connected in place of the existing secondary leads, the primary still being kept shunted by its resistance.

By rotating the transformer, tipping it up on end, etc., it should be possible to find a position where the hum is a minimum. The actual position may be very critical. It can then be fixed in this position and the primary connection remade.

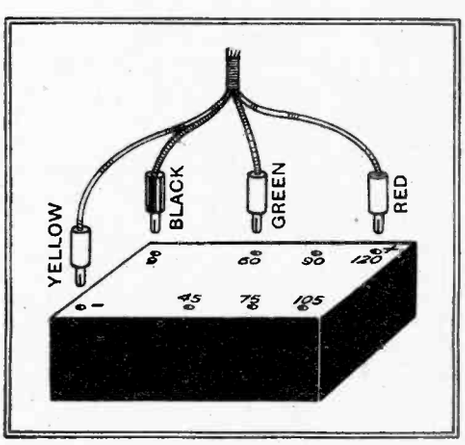
Battery Connections

IT is required to replace the HT battery in a small set and to use separate batteries for HT and grid bias in place of a single unit used hitherto. Some difficulty is being experienced in identifying the various leads shown in the drawing reproduced in the figure. One is obviously the HT negative and one the grid bias negative, but our querist has not yet succeeded in finding how to connect the grid bias positive of the separate battery.

Of the four leads shown, that with the black wander plug is the HT negative and the yellow the grid bias negative, nine volts grid bias being used.

If separate batteries are employed, another lead with a wander plug at one end will have to be connected to the cable lead terminating in the black wander plug. The added one will be inserted in the positive end of a 9-volt grid battery, and the yellow plug to the negative of this battery.

The original black plug then goes to the negative of the new HT battery, and the



The HT battery and cable connection which a reader requires identifying.

others to the sockets corresponding to those in the old battery.

Green is probably the detector HT supply and red the positive HT for other valves in the set.

Voltage Stabiliser

By D. P. TAYLOR

PREVENTING FLUCTUATIONS IN HT SUPPLY

DESCRIPTION of a valve-operated regulator for interposition in the HT supply circuit of certain measuring and testing instruments where a high degree of constancy is required. The system might also be applicable for minimising tuning drift in short-wave receivers, especially in cases where the mains supply is subject to severe voltage fluctuations.

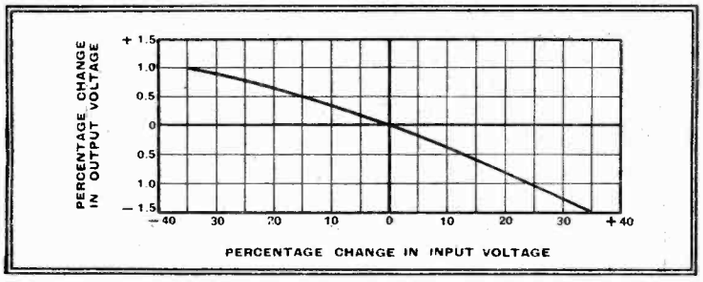


Fig. 2.—Showing that wide variations in input voltage produce comparatively small changes in output.

THE need for an anode supply, of which the voltage will remain constant despite variations of load current and mains voltage, has long been felt. Such a supply is essential for frequency meters, thermionic voltmeters, constant frequency oscillators and other precision apparatus, and to obtain it batteries are frequently used even though AC mains may be available.

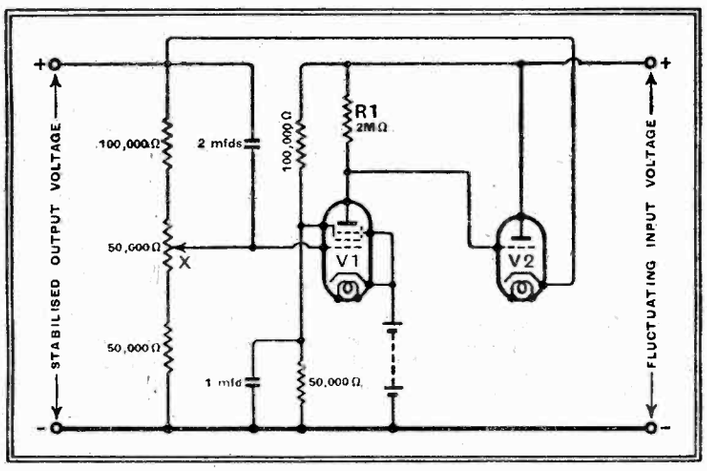


Fig. 1.—Circuit diagram of the voltage regulator, which is inserted between the source of H.T. supply and the load.

Voltage regulating circuits have been developed in America by the R.C.A. and Bell Laboratories which enable AC-operated power supplies to fulfil these requirements, and to compare with batteries in regard to voltage stability. The principle used closely resembles the AVC action in a receiver.

A regulator which will maintain a constant output voltage within narrow limits is shown in Fig. 1. The control valve V1, which is a high-magnification screen-grid or pentode type, is connected in series with a high resistance R1 across the input to the unit. The control grid of this valve is connected to a point on a potentiometer network across the output of the unit, so that a change of output voltage will vary the grid bias and so the anode current of the valve. This in turn changes the voltage drop in the anode resistance R1 and so the potential of the control valve anode will vary in sympathy with any variations of output volts. The regulator valve V2, a low-resistance triode, is connected in series with the supply, its grid being at the same potential as the anode of the control valve. Suppose an increase in output voltage occurs, the anode of the control valve becomes less positive, causing the grid potential of the regulator valve to move in a negative direction. The anode-cathode resistance of the regulator valve increases, causing an increased voltage drop and so pulls the output down to its original value.

In the case of a fall in output volts the reverse action occurs, making the grid of the regulator valve move in a positive direction, the effective resistance of this valve falls, allowing the output voltage to rise.

It will be noticed that a battery is shown in the cathode circuit of the control valve supplying a constant negative bias, the grid voltage of the valve being the difference between this fixed bias and the potential of the point X of the potentiometer. It is desirable that the voltage of this battery shall have a fairly large value so that the potential of the point X may be fairly large. If the point were 10 volts positive a variation of output voltage of 10 per cent. would cause the control grid potential to vary by one volt, whereas if it were at a potential of 50 volts a similar variation would cause a change of five on the grid. To get effective control it is thus necessary to use relatively large values of fixed bias so that percentage changes in output voltage shall cause large variations in control grid potential; it is advised in the interests of good regulation that the battery bias shall be at least 10-15 per cent. of the output voltage.

Limitations and Performance

As this type of regulator cannot "boost" up the voltage if the input voltage should fall too low it is necessary to have a sufficient voltage drop across the valve V2 to enable control to be effected for all reasonable variations and in practice the output voltage cannot exceed about 75 per cent. of the normal input

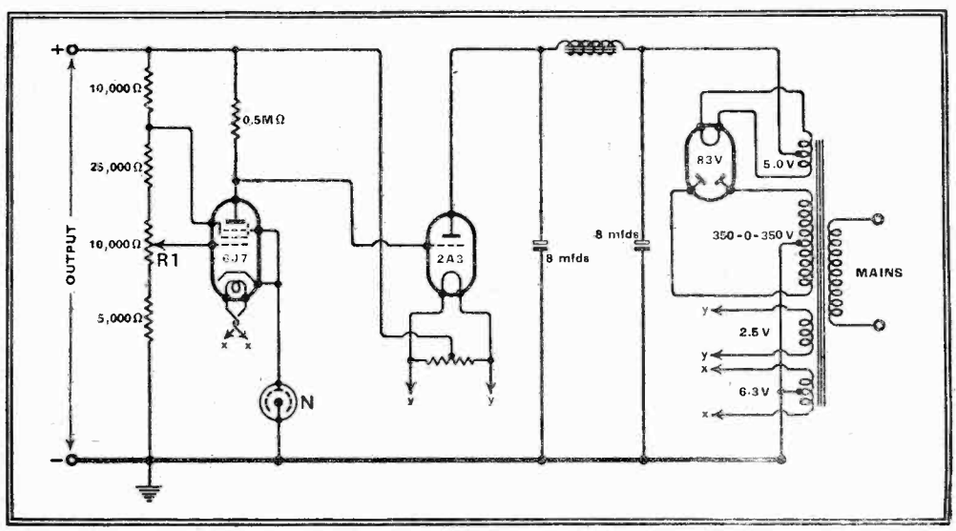


Fig. 3.—A complete voltage-stabilised H.T. unit. N is a 100-volt, 1-watt neon lamp with base resistance removed.

Voltage Stabiliser—

volts. Some idea of the performance of the regulator may be gained from the curve shown in Fig. 2. It will be seen that a variation of input volts between 25 per cent. and 30 per cent. is necessary to cause a change of 1 per cent. in output voltage. Further, by the use of the regulator unit the voltage regulation of an AC power supply was improved from roughly 30 per cent. to 0.5 per cent.

In Fig. 3 is shown a complete voltage-regulated AC power supply unit, designed by Grammer, suitable for working receivers, amplifiers and testing apparatus. It will be seen that the biasing battery has been eliminated by the use of a one-watt neon lamp in the cathode circuit of the control valve; this lamp also acts as a visual indication that the output voltage is under control. The output voltage will remain constant at 350 volts for any current between zero and 40 milliamperes or at 200 volts for load currents not exceeding 100 milliamperes. It is stated that at 200 volts output the voltage will remain constant despite primary voltage variations between 100 and 140 volts. A control of output voltage is obtained by the potentiometer R1. With this type of power supply unit the hum level is low, in spite of the simple filter unit used, as the regulator tends to "iron" out ripple in the output as well as power variations. A further advantage is that the effective impedance is very low and it may be used with high-gain amplifiers with a minimum of feed-back.

Letters to the Editor

The Editor does not hold himself responsible for the opinions of his correspondents

"Hum in AC Receivers"

I WAS extremely interested in Mr. R. E. Darnton's query and in the answer by Mr. D. Halliday which you have published recently.

This reminds me of a very interesting experience which I had a few years ago and of similar experiences since then. Those of my acquaintances who are technical experts in radio or power transmission are far from unanimous in their explanations, so that perhaps the problem would interest your readers.

A particular AC receiver was factory tested in the works by myself on standard mains. The hum level was quite normal. This set was installed fairly near to the works in a district that was only partly changed over from DC to AC. The set was then found to hum excessively. I had at the time no means of checking the supply voltage, but using the 250 instead of 230 tapping on the mains transformer only reduced the hum very slightly. On returning it to the works it was again tested and found O.K. It was returned to the customer and was left working with the excessive hum, as it was believed that this would disappear when the remainder of the street was changed over to AC. This proved to be the case, and the hum level was restored to normal.

I believe that the street cable was out of balance, but a power engineer tells me that this will not distort the wave-form. It should, perhaps, he added that there were three streets in the form of letter "H." At the time hum was experienced one vertical limb and half the horizontal were on DC and the other half on AC. I have also been told that supply companies vary in their methods of balancing cables, some "as they go" and others not necessarily until the scheme is more nearly complete.

Will Mr. Halliday or some other kind reader again oblige, please?

Manchester. R. D. DUCKWORTH.

Fibre Needles

HAVING read with considerable interest the recent correspondence in *The Wireless World* regarding the use of tone control and volume expansion with high-quality gramophone records, I should be glad to know if any reader has had experience of fibre needles with suitable tone correction.

This is a point of some importance, as the life of records is greatly prolonged when fibre needles are used, but, owing to the higher compliance of fibre over steel, I feel that transients must suffer even when the loss in the higher frequencies has been compensated for. Some years ago I took an output measurement at various frequencies, using steel and fibre needles, and, as far as I can remember, there was a drop of about 12 db at 5,000 cycles when using fibre and as compared with the steel.

Hornchurch. F. H. WALKER.

The British Radio Manufacturer

WE have read, with great surprise, in your columns during the past few months letters in which instances are given of alleged procrastination and a general lack of businesslike methods adopted by certain British radio firms when dealing with customers abroad.

In fairness to British firms in general, who, having been attacked as a whole, naturally cannot reply singly, we think that it is time something was said in their defence. We have for some time now been carrying out work which has necessitated much correspondence with British firms and, without exception, our enquiries have been met with the utmost courtesy and promptness, many of the firms supplying us with quantities of valuable literature for which we had not asked. In one instance we actually received a quotation by return air mail! The despatch of goods was also always carried out with the least possible delay.

In conclusion, may we suggest that the persons who made the allegations probably dealt with firms of questionable reputation and consequent slovenly methods.

Abbassia, Cairo. A. BATY.
P. A. SALE.

South Coast Regionals

I HAVE recently moved to a part of this country far distant from London, and one of the first things I missed was, and is, a *reliable* alternative station to Droitwich National. In fact, if it weren't for England's one and only long-wave transmitter I really don't know where many thousands of listeners would go for their entertainment, except abroad.

The part of the world in which I now dwell is, as I have just mentioned, a very great distance from London and other Regionals, and as it does not possess a station serving its own area the choice of home broadcasting is often limited to one. My receiver was new this year and cost 15 guineas, so my trouble in this respect is not due to inefficient apparatus; also, owners of the biggest and most powerful and sensitive of sets experience the same difficulty. The proprietor of the largest radio shop hereabouts told me recently that he is confined to Droitwich National for *reliable* demonstration of his wares.

This state of affairs has existed ever since broadcasting began, so it is more than high time it was remedied; and I now hear that this is being done. A transmitter is being erected at a point distant a few miles from this benighted spot, *just a few miles;* so very soon all should be well at. . . .

St. Leonards-on-Sea. T. J. E. WARBURTON.

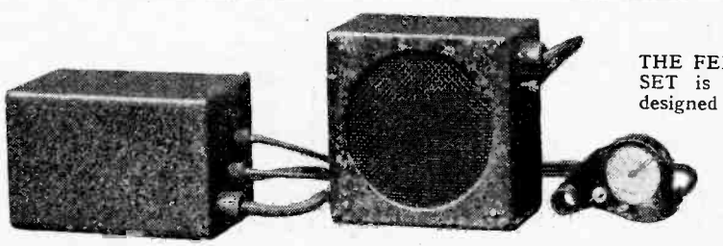
CAR RADIO

A PENTODE signal-frequency amplifier, heptode frequency-changer and tetrode output valve are features of the Ferranti car set, illustrated on this page. Arrangements have recently been concluded whereby matters appertaining to this receiver in London and S.E. England are dealt with by Car and General Radio, Ltd., of 38, Hugh Street, Eccleston Square, London, S.W.1, and in other districts by Ferranti, Moston, Lancs.

ON THE SHORT-WAVES

THE following extracts from the latest General Electric bulletin should interest most readers of this column:—

"The General Electric Company operates W2XAD and W2XAF on a non-profit basis, without charges for services rendered, for the purpose of improving the international broadcast field, furnishing listeners in other countries with programmes which



THE FERRANTI CAR RADIO SET is in three-unit form, designed essentially for easy installation in the typical British type of car.

would not otherwise be received and the building of international goodwill."

The bulletin goes on to state that: "The carrier power output on W2XAD or W2XAF is from 20 to 25 kilowatts. The effective carrier power when Alexanderson panel directive antennas are used is from 200 to 250 kilowatts.

"Class B low-level modulation is used on all transmitters."

Finally, a note is added as follows: "On or after June 1st, 1938, a radio-frequency power amplifier having a carrier power output of 100 kilowatts will be available for any of the assigned frequencies, i.e., 21.5, 15.33, 9.55 or 9.53 Mc/s.

Only W2XAD on 15.33 Mc/s (19.56 m.) now uses a beam on this country, and, apart from the omnidirectional transmission on W2XAF between 8 and 10 p.m. G.M.T., all the other transmissions, W2XAD 21.5 Mc/s, W2XAD 9.55 Mc/s, and W2XAF 9.53 Mc/s from 10 p.m. onwards, are directional on South America.

Gene Darlington's special weekly broadcast on Tuesdays is still to be heard over both W2XAD and W2XAF at 11.35 p.m. G.M.T. and after April 24th at 10.35 p.m. G.M.T. (or 11.35 p.m. B.S.T.).

For the greater part of the year W2XAD is probably the most "tuned-to" short-wave station in this country; it is certainly so in the evenings, although the afternoon performance of W2XE on 21.52 Mc/s is a close second.

One hopes that during the coming summer W2XAD or W2XAF will be able to use the 21 Mc/s channel, too, for early evening broadcasts to Europe, since the 15.33 Mc/s channel does not become really strong in midsummer until quite late in the evening.

The programme material radiated by these Schenectady stations, too, is generally of a very good standard, and they rarely leave themselves open to the following type of criticism, which appeared in an American radio monthly recently.

"If we had anything to do other than judging in this radiodor business—we'd nominate first as reek-of-the-month—any month out of the year—those domestic short-wave stations carrying excessive commercials. The worst offender of all is W9XJL on 26.1 Mc/s (incidentally W9XJL is well heard over here and uses GSK's channel), which station endeavours to sell double-decker beds to the Eskimos, fur coats to South Sea Islanders, and Tums to the African cannibals—providing they come to Superior, Wisconsin or Duluth to buy them. Because a few sponsors and commercial departments may consider us a nation of morons, they should not be permitted to encourage a similar opinion on the part of the rest of the world."

Evidently the American conscience is at last stirring to the necessity of restraining purely commercial announcements to reasonable limits.

Very often the sponsor's "blurb" amounts to nothing more than sheer bathos.

Note, the material quoted above was written by an able American short-wave journalist, Zeh Bouck.

During the past week I have been rebuilding my 14-28-56 Mc/s transmitter, and have converted the Xtal osc. and first two doubler stages to work entirely from D.C. mains.

The valve arrangement is now as follows: 7 Mc/s Xtal osc., 6D6, 1st and 2nd doublers KT31, the heaters being arranged in series, the 6D6 at the earthy end. The 0.3-amp. heater current is obtained via a Marconi 302 barretter.

These new Marconi-Osram AC/DC steep-slope, 10 mA/V, output tetrodes should have a considerable application in small transmitters or even in the earlier stages of larger transmitters, especially as the grid connection is brought out to the top cap, giving a low input capacity.

The heaters are brought out to three pins and therefore have the alternative ratings of 13 volts 0.6 amps. or 26 volts 0.3 amps., and can therefore be readily used on AC mains when a heater transformer delivering 13 volts is available. The equivalent 4 and 6.3-volt types do not possess the advantage of the top grid cap.

Owing to the mechanical construction, these valves may be plate modulated to a very high percentage without noticeable distortion, although, if desired, the screen may also be tied into the modulation circuit.

When used as an amplifier on 28 Mc/s, some degree of neutralisation is desirable, and for preference limiting resistances of about 1,000 ohms should be used in the anode and screen circuits.

Their slope or conductance of 10 mA/V compares more than favourably with the 6L6 or KT66—6.3 mA/V, and the standard U.S. pentode the 6F6-2.65 mA/V.

Finally, short-wave conditions still remain good and all the regular transmitters are giving a good service.

Newcomers are Helsinki (Helsingfors, Finland) on 9.50 Mc/s, a good signal in the early evenings, and Paris JPB2 on 17.78 Mc/s—the latter causing a bad heterodyne on W3XAL between 1 and 3 p.m. most afternoons. Bombay is now working near 60 metres, 5 Mc/s, in the afternoon, according to our time.

ETHACOMBER.

THE WIRELESS INDUSTRY

REDUCTIONS in the prices of the Exide "Hycap" range of LT accumulator cells have been made; as an example, type OCG3 now costs 8s. 6d. The Exide charge indicator is now being fitted in cells of the CZG range without increase in price.

National Radio and Television Service Company, 155 and 157, Great Portland Street, London, W.1, is undertaking the manufacture of heavy-duty amplifiers for use as permanent installations in theatres, arenas, etc. The same firm also undertakes the construction of high-quality amplifiers and receivers to clients' specifications.

A leaflet describing the E.T.L. Valve Tester (which includes a noise test) has just been issued by The Electrical Test Laboratories, Ltd., Triumph House, 189, Regent Street, London, W.1.

A leaflet and booklet dealing with the Ediswan Loud-Speakerphone are available from The Edison Swan Electric Co., Ltd., 155, Charing Cross Road, London, W.C.2.

The Solon electric soldering iron is being demonstrated on Henley's stand (No. 223 Main Hall Gallery) at the Ideal Home Exhibition.

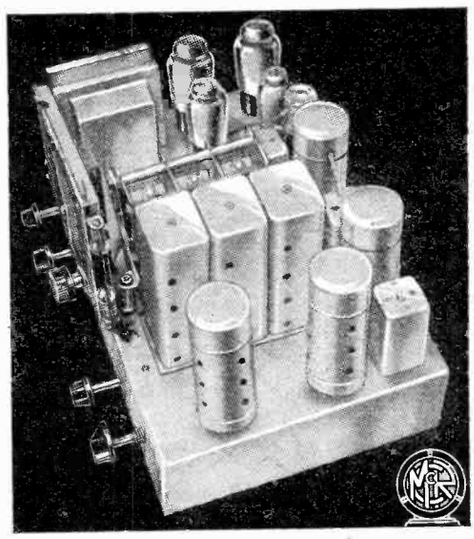
A new catalogue of Pifco productions has been issued by Provincial Incandescent Fittings Co., Ltd., Pifco House, 58, City Road, London, E.C.1.

Philips receivers Model 785AX have been chosen for installation in a number of schools in the Isle of Man.

The servicing of Milnes receivers will in future be undertaken by Bingley Radio Services, Church Street, Bingley. The staff of this firm is thoroughly conversant with the design of the receivers.

McCARTHY

The Chassis Specialists



IN modern radio practice, nothing is final; no receiver is so good that it is incapable of development in some detail.

Constant attention to improvement in small matters keeps McCarthy chassis in the forefront of modern chassis design and construction.

The receiver illustrated is the well-known McCarthy

9-VALVE 4-WAVE SUPERHETERODYNE

priced at 14 guineas including valves

The Circuit in Brief.—The pre-selector circuit is coupled to high-gain radio frequency amplifier operating on all 4 wave-bands, which is transformer-coupled to latest type triode-hexode frequency-changer. There are 2 band-pass transformer-coupled I.F. amplifiers (intermediate frequency 465 K.C.'s). The double diode second detector provides automatic volume control applied to 4 preceding valves, and first stage L.F. amplification. The triode phase-changer is capacity-coupled to push-pull output pentodes (or Harries-tetrodes) delivering 9 watts.

Principal Features.—Waveband coverage—12.8-33, 29-80, 190-550, 800-2,000 metres. Controls—sensitivity control (varying bias on R/F stage): 5-position wave-change and gramophone switch combined volume control and on/off switch and progressive variable tone control (both operative on radio and gramophone).

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Send 3d. in stamps for complete illustrated catalogue with technical data and circuit diagrams of other interesting McCarthy chassis of all types for A.C., Battery or A.C./D.C. Abridged list free of charge.

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By "DIALLIST"

Not Always Behind

BEFORE now I have been amazed to come across something which we have long regarded as a commonplace in radio hailed by American papers as the most complete novelty. I suppose we've got so much into the habit of thinking that most new developments in, at any rate, the reception of broadcast wireless come from the States that we imagine that our own doings in that field can contain little that is new to them. But we aren't always behind; in fact, we are often a good long way in front, though we don't always realise it. We had, for example, apparatus for receiving still pictures or facsimiles of letterpress with an ordinary set long before such a thing was heard of in the U.S.A. And what about the screen grid valve? Or the HT battery that can be recharged from a 6-volt accumulator? By the way, I recently came across a British firm, now taking an interest in the export market, which was toying with the idea of using American air-cells that can't be recharged, and didn't know that air-cells that *can* had been manufactured for many years in this country.

Television, Too

There is no question either that we are streets ahead of America in the matter of television, and that our accomplishments in that field are comparatively little known to Americans. In *Radio News* for April, 1938, I find, for example, Commander E. F. McDonald, president of the Zenith Radio Corporation, answering the question, "Is Television Here?" with a decided No. He says, "Even with the finest laboratory equipment experts have been unable to project clear pictures more than 27 miles." He goes on to remark that "changes in television transmitting apparatus have been so rapid and so continuous that television receivers sold only one year ago are now obsolete." He concludes with the surprising statement, "Television is coming, but it is *not* just round the corner." That's just the kind of thing that might have been written in a British paper about three years ago; but we should laugh at anyone who made such out-of-date remarks in any paper of ours to-day.

Plenty of Choice

HOW many firms would you guess are now making television receivers in this country? I believe that the number is eighteen, and there are certainly sixteen with televisors already on the market. Excluding big-screen instruments and taking only those which show images from 6×7½in. to 13½×11in., there are more than forty models to choose from, ranging in price from 30 guineas to 170 guineas. The former price is for the G.E.C. apparatus for vision reception only, sound being reproduced by the ordinary wireless set by means of a converter; the luxury instrument is the R.G.D., which includes an "all-wave" auto-radiogram. There is, therefore, plenty of choice in the matter of television receivers, and there are not a few which can be bought for no more than the cost of a high-grade radio receiver. There are actually ten models which cost less than £50 apiece and two at under £40.

Cars and Television

A NEAR neighbour of mine who is a television enthusiast, if ever there was one, has installed a first-rate television receiver, but finds that, as a rule, he can obtain satisfactory reception of the evening programmes only. The reason is that he lives in a road along which there is a great deal of motor traffic during the daytime, which means that interference with both sound and vision is terribly bad. Unfortunately, he can't erect an aerial high enough to be completely clear of the field of interference, and that must apply to many would-be owners of televisors. Don't you think it's about time that we took this business of car-ignition interference on the ultra-short waves seriously? There is no question that it is one of the factors which prevents television from going ahead more rapidly, and unless steps are taken it is likely to grow much worse, for the motor traffic on our roads is increasing every day. A clause dealing with this kind of interference might very well form part of the Bill dealing with interference generally which has been so long awaited.

When's That Bill Coming?

When *are* we going to have the legislation dealing with interference that was foreshadowed a long, long time ago, after the Committee enquiring into the subject had presented its report? One can see no reason whatever now for delay. Exactly what constitutes interference has been laid down and the ways of preventing it are well known. It was said some time ago that the various Wireless Telegraphy Acts were to be redrafted into a single comprehensive Bill and that interference would be dealt with by this. But there are no signs of that Bill and interference is growing worse. A recent letter in *The Wireless World* showed that one large firm at any rate is still selling vacuum cleaners that interfere badly, and plenty of other apparatus that offends is being sold. The Government could have stopped this long ago by issuing a warning that their Bill would prohibit the use of such apparatus or make it compulsory for the owner to have it "silenced" at his own expense. They did nothing of the kind, and when the Bill does come it will now probably have to allow interfering apparatus to remain in use for

Broadcast Programmes

FEATURES OF THE WEEK

THURSDAY, APRIL 14th.

Nat., 6.40, What Makes a Play Successful?—a discussion. 8, "Rhythm Express," with Benny Frankel and his Orchestra. 8.45, Reading from American humorous literature (from America).

Reg., 6.35, "The Seven Words from the Cross"—Heinrich Schutz. 9, "Gallery Goddess"—a romantic comedy of the theatre.

Abroad.

Budapest, 7.10, "The St. Matthew Passion" (Bach).

Milan, I, 9, "Requiem Mass" (Verdi), from La Scala.

FRIDAY, APRIL 15th.

Nat., 6.30, Church of England service from St. Sepulchre's, Holborn. 8 and 9, "The Dream of Gerontius" by Elgar. The B.B.C. Symphony Orchestra and the B.B.C. Choral Society conducted by Sir Henry Wood.

Reg., 7.30, Mazurkas by Chopin and Szymanowski, played by Jan Smeterlin, pianoforte. 8.45, An Enquiry into the Existence of Mermaids.

Abroad.

Prague, I, 8.5, "Stabat Mater" (Dvorák).

Hilversum, I, 9.10, "The Passion of Our Lord," by the Schola Cantorum.

SATURDAY, APRIL 16th.

Nat., 8, Palace of Varieties, including George Robey and Florence Oldham. 9.20, American Commentary. 9.35, Fifty Years of League Football—the History of the Game's Organisation.

Reg., 6.30, Billy Cotton and his Band. 7.30, Easter Carols and Hymns. 9, "Vivanti," a play about the villainous character created by Sydney Horler.

Abroad.

Milan, I, 2.45, "Silvano," opera (Mascagni).

Rome, I, "Cleopatra," opera (La Rosa Parodi).

SUNDAY, APRIL 17th.

Nat., 7.15, "The St. Lawrence"—feature programme from Canada. 9.5, "Tales of Vienna"—light music from Vienna.

Reg., 5.30, Easter Music—organ and choral from Lithuania. 6, Round the Courts. 9.5, Sunday Orchestral Concert conducted by Sir Adrian Boult—Easter Oratorio.

Abroad.

Berlin, 8, "The Merry Widow"—operetta (Lehár).

Kalundborg, 8, Bach Society Concert relayed from the Cathedral, Copenhagen.

MONDAY, APRIL 18th.

Nat., 7, Monday at Seven. 9.20, World Affairs. 9.35, Television at Work—a commentary by John Snagge on the demonstration of air defence at Alexandra Palace.

Reg., 8, Spain—both sides of the line. 8.20, Geraldo and his Concert Orchestra, with Anne Ziegler and Eve Becke. 9.20, Excerpt from "Wild Oats."

Abroad.

Deutschlandsender, 8, "A Night in Venice," operetta (Johann Strauss).

Stuttgart, 10.30, "Martha," opera.

TUESDAY, APRIL 19th.

Nat., 7, Gounod's opera "Faust"—the B.B.C. Chorus (C) and the Theatre Orchestra, conducted by Stanford Robinson. Narration spoken and written by Wilfrid Rooke-Ley. 9.20, America Speaks.

Reg., 6.40, "From the London Theatre," Raymond Massey and Tamara Geva in extracts from "The Idiot's Delight." 8.10, Commentary on Ladies' Darts Championship.

Abroad.

Paris, PTT, 8.30, "The St. John Passion" (Bach).

Turin, 9, "Aida," opera (Verdi).

WEDNESDAY, APRIL 20th.

Nat., 7.20, "Hail Variety" II, with Ella Retford, commère. 8 and 9.20, Sir Adrian Boult conducts the B.B.C. Symphony Orchestra at Plymouth.

Reg., 6.30, "Swift Serenade." 7.30, "The World Goes By." 8, "Band Waggon." 9, "A Rural Ride Renewed." S. P. B. Mais and M. McLaren follow in Cobbett's footsteps. 9.30, After Dinner Cabaret.

Abroad.

Cologne, 8, Beethoven Festival.

Rome, 9, "Die Frau ohne Schatten" opera (Richard Strauss), from the Royal Opera.

some little time to prevent the cry of hardship from those who have recently bought it.

A Reminder

Speaking of interference reminds me that I come across an extraordinary number of people who don't know what to do when their reception of the wireless programmes is spoilt by nasty noises of man-made origin. Readers can do both their friends and the Post Office a good turn by letting it be known that bad interference should be reported on the form that can be obtained over the counter at any post office. The G.P.O. engineers concerned with radio interference deal with many thousands of cases each year, and, though they cannot compel offenders to do anything, their tactful handling of the matter very often leads to a great improvement, if not a complete cure. Where they can't induce those who cause the interference to end it they give the listener valuable advice about ways of obtaining better reception by means of anti-interference aerials, disturbance suppressors and so on.

Unreasonable

A GOOD many people are pretty unreasonable in what they expect of their wireless sets. Only the other day a man I know asked me the old, old question, "Why can't wireless sets be as reliable as motor cars?" His trouble, I found, was that after using a set of good make for eighteen months he had had to spend 12s. 6d. on having a new volume control fitted. That was the only repair of any sort or kind that had been necessary. I pointed out to him that whereas motor cars require and get pretty constant attention in such matters as keeping the tyres at the right pressure, filling up the radiator and the sump, topping-up the battery and so on, the average wireless set is left to fend for itself until it breaks down. And motorists don't grumble when they have to have engines decarbonised and the valves ground in after doing some thousands of miles. The volume control gets a great deal of work in some wireless sets. Of course, it shouldn't break down after eighteen months' use; but I don't think that anyone whose total repairs, adjustments and renewals bill for that period come to 12s. 6d. has very much to grouse about.

A Matey Affair

I MUST say that I thoroughly enjoyed the Spelling Bees that we have had, especially the one in which the men were so soundly whacked by the alleged gentler sex. This one in particular got rid of any of the starchiness that is apt to characterise many studio items and produced a refreshingly intimate atmosphere. Mr. Freddy Grisewood was in excellent form and struck just the right note, as did the members of the teams under his sway. Most readers, I expect, are looking forward to the B.B.C. *versus* Listeners' match billed for Sunday, May 1st. The B.B.C. mustn't, of course, work Spelling Bees to death, and I think that they are wise in having an interval of a month between these two. But the Spelling Bee may beget other ideas for informal and intimate programmes in which listeners themselves can take part. I have already suggested "Do You Know?" competitions, and there are heaps of other possibilities on these lines. Mental arithmetic with a very short time limit for answers might be useful. Geography is another possibility, and many more subjects will come into your head if you start thinking about them.

Television Programmes

Vision 45 Mc/s. Sound 41.5 Mc/s.

THURSDAY, APRIL 14th.

3, A Relay from the Television Studio at the Ideal Home Exhibition, Olympia. **3.10,** "Weather or No"—light entertainment, including Walter Gore and William Stephens. **3.30,** British Movietonews. **3.40,** 137th edition of Picture Page.

9, As at 3 p.m. **9.10,** As at 3.10 p.m. **9.30,** Gaumont-British News. **9.40,** 138th edition of Picture Page. **10.10,** News Bulletin.

FRIDAY, APRIL 15th.

3, David Seth-Smith presents "Friends from the Zoo." **3.15,** Gaumont-British News. **3.25,** From Bach and Handel, song, dance and instrumental music, with Sidonie Goossens, Margot Fonteyn and Richard Watson.

9, British Movietonews. **9.10,** "Everyman," a masque by Pepler, with Alexander Knox in the name part. **10.5,** News Bulletin.

SATURDAY, APRIL 16th.

3, From the Ideal Home Exhibition. **3.15,** Cartoon Film. **3.20,** Cartoons by H. S. Foxwell. **3.30,** British Movietonews. **3.40,** Variety, including Albert Whelan and Joe Young.

9, From the Ideal Home Exhibition. **9.15,** Ballroom Dancing. **9.30,** Gaumont-British News. **9.40,** Variety, as at 3.40 p.m.—in addition, Horace Kenny and Co. in "The Frontiersman." **10,** News Bulletin.

SUNDAY, APRIL 17th.

8.50, News. **9.5,** Pianoforte Recital. **9.15,** Cartoon Film. **9.25,** "The Marvellous History of St. Bernard," a play adapted by Henri Gheon, from a manuscript of the 15th century.

MONDAY, APRIL 18th.

3, From the Ideal Home Exhibition. **3.10,** Starlight. **3.20,** British Movietonews. **3.30,** The Anti-Aircraft Defence of London. A display by the First Anti-Aircraft Division (T.A.). Commentary by Leslie Mitchell.

9, From the Ideal Home Exhibition. **9.10,** Starlight. **9.20,** Gaumont-British News. **9.30,** As at 3.30 p.m. **10,** News.

TUESDAY, APRIL 19th.

3, From the Ideal Home Exhibition. **3.10,** Stanelli's Bachelor Party. **3.30,** Gaumont-British News. **3.40,** "The Maker of Dreams," a fantasy by Oliphant Down.

9, From the Ideal Home Exhibition. **9.10,** Starlight, **9.20,** Judo, the art of self-defence. **9.35,** British Movietonews. **9.45,** "Oroastus," a Greek tragedy by S. Leacock, and "Hamlet, the Worker," a burlesque by Wilfrid Walter. **10.25,** News.

WEDNESDAY, APRIL 20th.

3, From the Ideal Home Exhibition. **3.10,** Starlight—Irène Prador. **3.20,** British Movietonews. **3.30—4.15,** "Anything May Happen." A Ruritanian Operetta to end all Ruritanian Operettas. Cast includes Richard Murdock, Jean Colin and Charles Wade.

9, From the Ideal Home Exhibition. **9.10,** Spontaneous Swing Music. **9.30,** "All Eyes on Everest," talk by Michael Spender. **9.45,** Cartoon film. **9.50,** Starlight. **10,** News.

COSSOR MODEL 393

A New "Melody Maker"

THIS is the eleventh of a series of battery sets which have established a reputation for efficiency of performance from circuits of simple design. Three pentode valves are used in a straight circuit which is housed with an 8in. moving coil loud speaker in a neat walnut cabinet measuring 17½ by 14½ by 10in.

The two waveranges cover 200-560 and 826-2,000 metres and the glass-covered tuning scale is calibrated in wavelengths and carries 38 station names. There is provision for an extension speaker and gramophone pick-up, and the price without batteries is 5 guineas.

T.C.C.
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TROUBLE

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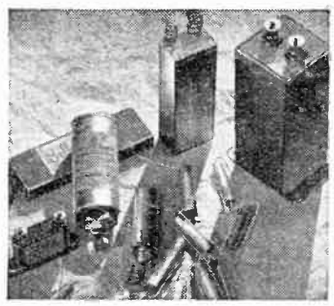

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Recent Inventions

The British abstracts published here are prepared with the permission of the Controller of H.M. Stationery Office, from Specifications obtainable at the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1/- each. A selection of patents issued in U.S.A. is also included.

Brief descriptions of the more interesting radio devices and improvements issued on patents will be included in this section.

SELECTIVITY CONTROL

IT has already been proposed to vary the selectivity of one or more of the tuned circuits of a set by using a triode valve as a variable shunt or damping resistance. The objection to this arrangement is that the damping valve is liable to introduce distortion, particularly when it is biased down near the cut-off point.

By way of remedy the triode is replaced by a pentode valve, which is used as a shunt either across the tuned input or one of the intermediate-frequency circuits of a superhet set. This provides a more effective regulation of selectivity over a wider range of wavelengths, without introducing any appreciable distortion. A switch is provided so that the biasing voltage applied to the grid of the auxiliary pentode may be derived either from the AVC line for adjusting selectivity automatically, or by manual control from a variable tapping on a potentiometer.

Marconi's Wireless Telegraph Co., Ltd. Convention date (U.S.A.) May 31st, 1935. No. 476486.

o o o o

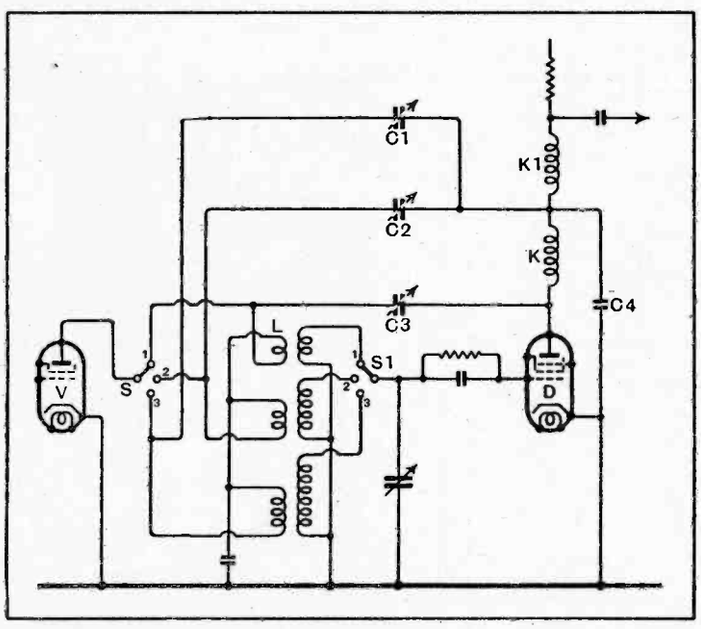
ALL-WAVE SETS

IT has been found difficult in practice to apply stabilised reaction throughout the whole range of a multi-wave set. The figure shows a circuit designed to overcome this difficulty. A switch S, which is ganged with the wave-change switch, is moved to the upper contact 1 on the short-wave setting, so as to bring a coil L into the output circuit of the radio-frequency or intermediate-frequency amplifier V.

Simultaneously a second switch S1 is also moved to its upper contact to complete the input circuit to the detector valve D. In this position a choke K in the anode circuit of D is designed, in combination with the condenser C4 and the inter-electrode capacity of the valve D, to tune to a frequency which lies towards the lower limit of the short waverange. A preset condenser C3 then resonates with the coil L towards the upper limit of the same waverange and provides stabilised feed-back.

On the medium-wave contact 2 of the two switches S, S1, the choke K1 comes into action and resonates at the lower end of that waverange, the condenser C2 then providing the required feed-back. Similarly, C1 provides reaction on the long-wave setting. Owing to the different values of the condensers, and to the fact that they are in shunt with each other, each exercises a substantially independent control on each waveband.

E. K. Cole and H. A. Brooke. Application date October 3rd, 1936. *No.* 478754.



Method of obtaining constant reaction over a wide band of radio frequencies.

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FOCUSING THE ELECTRON STREAM

IN a cathode-ray tube, of the type in which an electron stream of large cross-section is focused throughout its length by the magnetic field from an external winding, there is a tendency for the edges of the picture to become blurred owing to the falling-off in field-strength towards each end of the magnetic coil.

As it is not practicable to extend the length of the coil beyond the neck of the tube, the windings are, according to the invention, "stepped" in cross-section so that the effective number of turns is greater at each end of the coil than in the middle, thus reinforcing the field strength where it is required. Alternatively, two auxiliary windings may be arranged at each end of the main winding for the same purpose.

Fernseh Akt. Convention date (Germany), July 23rd, 1935. *No.* 478666.

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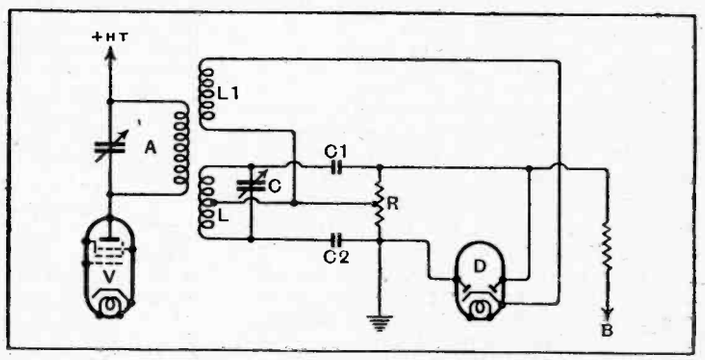
AUTOMATIC TUNING CONTROL

ANY initial error in tuning is automatically corrected by utilising two control voltages, both derived from the incoming signal, one having a fixed phase-relation to it, whilst the other varies in phase according to whether, and to what extent, the receiver circuits are tuned above or below the correct signal frequency. If, for instance, a circuit carrying the signal energy is loosely coupled to a tuned circuit of the receiver, the voltage induced in the latter will be in quadrature with the signal voltage if both circuits are in tune, but otherwise it will vary in phase according to the sense and degree to which the second circuit is out of tune.

As shown in the Figure, the tuned anode circuit A, say, of an intermediate-frequency amplifier V is loosely coupled with a secondary tuned circuit L, C, the inductance of which is centre-tapped and coupled through condensers C1, C2 to a resistance R. Both the inductance and resistance are branched across the two anodes of a diode rectifier D. The cathode circuit of the latter is also loosely coupled at L1 to the primary circuit A. The in-phase tuning-correction voltage is derived across the resistance R, one end of which is earthed, whilst the other goes to the biasing line B.

Murphy Radio, Ltd. and H. D. Ellis. Application date, June 17th, 1936. *No.* 478356.



Circuit details of automatic tuning corrector.

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DIRECTION FINDERS

WHEN taking bearings on a distant transmitter by a frame aerial it is customary to switch-in the pick-up from a vertical aerial in order to show the correct "sense" of the bearings, and so remove the usual 180 deg. ambiguity.

The combined effect of the two aerials is a cardioid curve. But the "minimum" point on this curve is displaced by 90 deg. from the true bearing direction, so that it is usual to provide an auxiliary pointer on the indicator scale set at 90 deg. to the main pointer.

The object of the invention is to arrange matters so that the "minimum" point on the cardioid curve is automatically aligned with the true direction of the distant transmitter so that the usual 90 deg. correction becomes necessary. This is accomplished by winding the search-coil of the radio-goniometer in two parts which are set at right angles to each other. One or other of these is then switched into circuit simultaneously with the sense-determining aerial.

Panstowe Zaklady Teleradjotechniczne, Warszawie. Convention date (Poland) July 10th, 1935. *No.* 477963.

o o o o

SHORT-WAVE AERIALS

FOR transmitting television signals it is common practice to use a half-wave aerial fed at one end by a concentric feed-line. The average impedance of such an aerial is about 2,000 ohms, whilst that of the feed-line is of the order of 100 ohms. It is therefore necessary to find some way of matching the two impedances in order to ensure an efficient transfer of energy to the aerial.

One possible solution is to use a transformer coupling having a suitable step-up ratio. This would, however, introduce a considerable amount of selectivity, which is not desirable, since a television aerial should be capable of handling a very wide band of signal frequencies without discrimination.

According to the invention, the problem is solved by replacing the ordinary wire or rod dipole by an aerial having a large surface area, such as an open tube of metal or wire-gauze, or a group of parallel wires arranged in the form of a cylinder. For a wavelength of 6.5 metres a tubular aerial having a diameter of approximately one foot gives a reasonable impedance match.

E. C. Cork and J. L. Pawsey. Application date July 10th, 1936. *No.* 477914.

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As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

CONTENTS

	Page
Editorial Comment	347
The Home Laboratory—I	348
Are High-Slope Valves Wanted?	352
Television Topics	354
Germany's "World Sender"	355
The Ultra-High Frequencies	356
H.M.V. Model 653 Reviewed	358
News of the Week	360
Unbiased	362
Why Maths?	363
Readers' Problems	364
Random Radiations	366
Broadcast Programmes	366
Recent Inventions	368

EDITORIAL COMMENT

Export Wireless

Necessity for Standardisation

ON several occasions in the past we have urged that the overseas market for British receivers is in such an unsatisfactory state that only drastic and somewhat revolutionary action will suffice to set it on its feet. We recommended that British set manufacturers should get together and agree upon a standard design for export which all manufacturers would follow with the object of avoiding competition between themselves. This would result in a receiver at a competitive price, and, even more important, by means of standardisation only a minimum of spare parts would have to be stocked by overseas distributors. Servicing problems would be reduced to a minimum.

Confirmation of Our Views

We have lately had the opportunity of seeing a letter addressed from a firm of export merchants in South Africa to their head office in London. This letter is a strong endorsement of the views which we have held for so long. The letter states that British radio manufacturers "have allowed the American manufacturers to capture this market, and it is important to note that until the British radio manufacturers get together as a complete industry and imitate the methods of their American rivals, they are unlikely to do anything important on the overseas markets. . . . The Americans have standardised their components and circuits, thereby not only decreasing their production costs, but at the same time making the servicing of American radios a comparatively simple matter.

"So long as the British radio manufacturers work in water-tight compartments, each following his own scheme, they must be well beaten by an organised industry such as the Americans have arranged."

Once more we commend these views to the British wireless industry.

Television Propaganda

How the B.B.C. Can Help

IF, as we should assume, the B.B.C. is anxious to make television broadcasts a success and to stimulate interest amongst listeners to acquire television receivers, we think more should be done by the B.B.C. in the way of propaganda.

In connection with the recent Boat Race commentary, the announcer mentioned that those who had television sets would have an opportunity of seeing the finish of the race. This is just one example of what the B.B.C. might do far more frequently in order to make listeners television-conscious.

We recognise that the B.B.C. does now make occasional references to television on the normal sound programmes, but it would take up little time, and should be most effective in results, if the television programmes were announced daily, say, after the first news or some other appropriate time.

Such announcements could not be regarded as in the nature of advertising, since they would be general in character and would not, of course, refer to any make of television receiver in particular.

These references should, for the present, we feel, be confined to London-area programmes, to avoid tantalising those outside the service area of Alexandra Palace with such reminders.

The Home Laboratory

Part I— VALVE VOLTMETERS

By M. G. SCROGGIE, B.Sc., A.M.I.E.E.

A YEAR or two ago a short series of articles appeared under the title of "The Home Laboratory." In response to requests for more of this nature, and particularly for information about actual instruments, here is the first of a similar series which also foreshadows the appearance of a book in which the whole subject of radio laboratory work—amateur and professional—will be treated in detail.

ONE very important instrument—or, perhaps, rather class of instruments—that was treated extremely sketchily in the first series of "Home Laboratory" articles[1] is the valve voltmeter. Although it was felt that information in plenty about valve voltmeters was already available, the type recently designed by the writer as the result of about fourteen years' experience with them may be sufficiently unusual to be interesting.

Although the valve voltmeter is such a valuable tool, and for some purposes has no serious rival, enthusiasm must not be allowed to blind one to its disadvantages. It is less simple and convenient than a straightforward meter, so would not be used in preference to it where both are applicable. For example, the owner of a metal rectifier meter would not use a valve voltmeter to measure or indicate the output of a receiver. The metal rectifier is more robust, simpler, and more convenient. The fewer accessories there are, such as batteries, the more reliable an instrument is likely to be. Generally the accuracy of a valve voltmeter, especially for readings less than about one volt, depends on a variety of things, such as filament, grid and anode voltages, and valve characteristics. If a lot of trouble has been taken to obtain a very accurate calibration it is not enough to do it once and thereafter rely on it for ever.

As a general principle, therefore, it is preferable where possible to use such instruments as *indicators* rather than *meters*, and particularly to avoid having to take readings over a wide range of voltage in one experiment. It is usually better to make the result of a measurement depend on adjusting two voltages to be equal, rather than on actual voltage readings. The accuracy of calibration, or even calibration at all, is then of no importance.

Nevertheless, it certainly is very useful to have a calibrated voltmeter, available at all frequencies, including the ultra-high, and which disturbs the circuit less than any other type, even if its volt readings are not always relied upon. And by suitable design it is possible to ensure that at least the larger readings are as reliable and permanent as those of any other sort of voltmeter.

In essence the valve voltmeter is simply a valve operated at a curved portion of its characteristic so as to rectify the alternating voltage and give an indication on a meter, usually in the anode circuit. The detector valve in any receiver can be converted into a valve voltmeter for measuring its own circuit, by the addition of a meter; and often this is actually quite a sensible thing to do, because the disturbing effects of introducing measuring apparatus into the signal circuit are completely avoided.

Before going much further it is important to ask what sort of volts one wants to measure. A valve voltmeter can be arranged to approximate to peak, mean, or RMS values. So long as one is measuring pure sine waves it does not greatly matter which, because the values are related by fixed ratios and are readily interchangeable (1 peak volt = 1.404 RMS volts = 1.57 mean volts); but these proportions alter when the wave is distorted or mixed with others, as illustrated in Fig. 1. The RMS value is the one that is generally assumed, unless the contrary is stated, because for most purposes (such as heating and power) it is the effective voltage regardless of waveform. A peak, or mean, or any other sort of voltmeter can be fitted with a scale of RMS values which will be correct for sine waves, but when used to measure AC of other waveforms it will be inaccurate. Unfortunately a true RMS voltmeter must be of a type giving a deflection proportional to the square of the voltage. It is possible with a little care to get a close approximation to a square law by working a suitable valve as an anode bend detector near the foot of its characteristic, but only over a limited range of voltage. Moreover, a square law scale is crowded near the minimum, so does not enable good readings to be taken over nearly such a wide range of voltages as a linear (i.e., uniformly divided) scale such as that of a moving-coil DC meter. A sensitive indicating instrument is needed in the anode circuit. Another disadvantage is that the readings are particularly liable to be affected by valve-operating voltages and characteristics. Therefore, it is probably necessary to provide means for checking these voltages. So, although a RMS valve voltmeter is very desirable, it lacks the virtues of wide range, simplicity, cheapness, reliability, easy use and permanence of calibration.

If the one advantage of freedom from waveform error is sacrificed it is possible to produce a much more practical type of apparatus.

For Low Readings

The most sensitive is the unbiased grid-leak type, and if one is interested chiefly in voltages less than 1 it must be considered; but its range of measurement is very limited, and it is one of the worst for input losses and variability of calibration.

Perhaps the most popular is the auto-bias type, for it can easily be adapted to

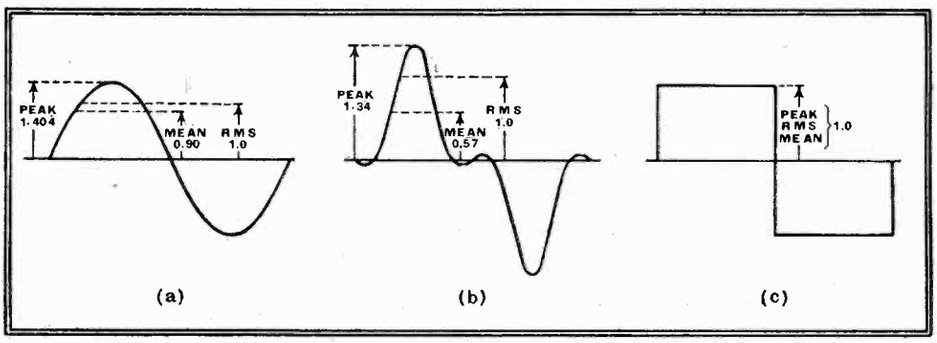


Fig. 1.—Showing how the proportions between peak, mean and RMS values of alternating current or voltage vary with the waveform. Different types of meters are therefore liable to give different readings unless the waveform is pure, (a). Diagram (b) shows 50 per cent. third harmonic with the peaks in phase; and (c) is the extreme case of a flat-topped wave.

[1] *The Wireless World*, 1936. July 17th, 24th and 31st, and August 7th and 14th.

The Home Laboratory—

different ranges by switching various bias resistors into circuit. The auto-bias, being of the nature of a negative feed-back system, tends to stabilise the indications, rendering them less dependent on valve characteristics and supply voltages; but, of course, at some sacrifice of sensitivity. Both of the two last types tend to read mean values over most of their ranges. In this respect they resemble the familiar metal rectifier instruments.

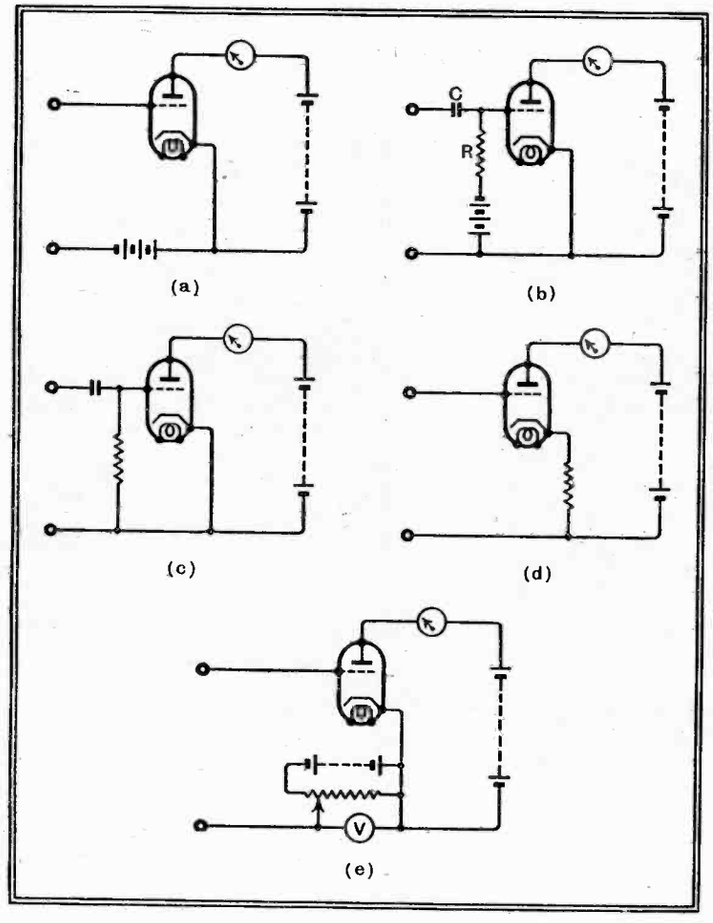


Fig. 2.—Basic circuits of some different types of valve voltmeter: (a) anode-bend; (b) the same with indirect input; (c) grid detection; (d) auto-bias or reflex, and (e) slide-back. Usually (a) tends to respond to the RMS value of voltage, (c) and (d) to the mean value, and (e) to the peak.

Basic Circuit Arrangements

Fig. 2 illustrates the distinctive principles of the valve voltmeters so far described—(a) is the anode-bend type, preferably operated to give as nearly as possible RMS readings; (b) is the same modified for use where the circuit to be tested would alter the grid bias or cut it off altogether, as when there is DC or a condenser. This modification is available for any type, but increases the input losses somewhat; (c) is the "grid" type, and (d) is the auto-bias type.

One of the chief disadvantages of most valve voltmeters is that not only is a more or less sensitive (and, therefore, expensive) moving-coil indicator required, but it is very liable to be damaged by accidental excessive current, due, for example, to the grid bias being interrupted.

For all purposes where a square law voltmeter is not essential, the writer favours the somewhat neglected species known as the "slide-back". It measures peak volts (which for radio purposes is in itself sometimes a very useful feature) and it is possible to design it to be:—

1. Practically unaffected by supply voltages and valve characteristics.
2. At least as near infinite input impedance as any other type.
3. Sensitive to 0.1 volt input without any microammeter or other sensitive indicator.
4. Incapable of being damaged by careless use.
5. Extended to read voltages of any magnitude.
6. Available as a currentless DC voltmeter.
7. Extremely sensitive for *comparing* voltages.

The broad principle is to adjust the grid bias of a valve until the anode current is just reduced to zero in the absence of signal. When the signal is applied, an additional grid bias is needed to reduce the current again to zero, and this bias voltage is equal to the peak signal voltage, and is a measure of it. Theoretically, the valve characteristics do not affect the result at all, and the problem resolves itself into the simple one of measuring a DC voltage.

In practice it does not work out so simply, and the unpopularity of the slide-back voltmeter is probably due first to the need for providing the slide-back voltage and adjusting it to equal the signal, and secondly to certain difficulties and errors resulting from the deceptiveness of its apparent simplicity.

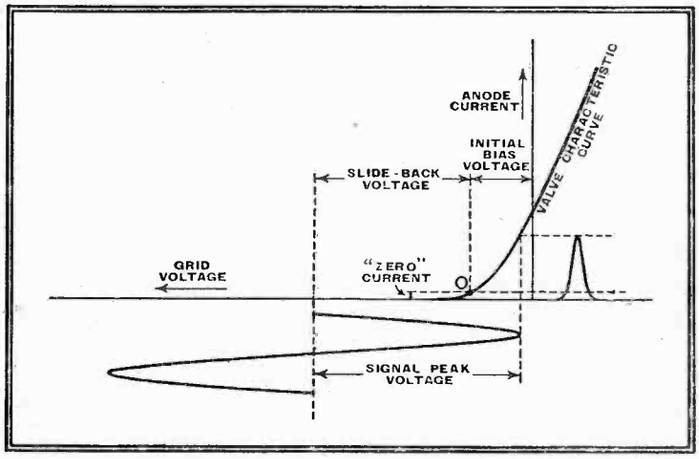


Fig. 3.—Explaining the working of the slide-back voltmeter.

In the design to be described the initial adjustment has been made very quick and easy, and the other difficulties have been overcome. Chief among these difficulties is that the bias corresponding to "zero" anode current may be anything within a volt or two, according to the sensitivity of the anode-current meter. What looks like zero on one instrument might be full-scale reading on another. The sensitivity of adjustment is at its very worst where the anode-current curve merges imperceptibly into the base line. So it is necessary to adjust to some definite anode current. In actually deciding on the amount one runs into a dilemma. For one thing, if a large "zero" is adopted the meter by which it is indicated is not sensitive to small changes, and the adjustment cannot be made to close accuracy. Again, if the "zero" is not very small the valve is an imperfect rectifier—the change in anode current due to a signal is the net result of a downward as well as an upward swing—and the bias voltage needed to counteract a small signal voltage is smaller still. The slide-back voltage is therefore not truly equal to signal peak voltage, and the beautiful simplicity of the idea is spoilt. Very weak signals are not measurable at all. With so small a "zero" as 0.5 *micro*-amp. the curvature is seriously noticeable below 0.5 volt signal, and about 0.2 volt is the smallest measurable.

The Zero Point

There is another form of error that affects all readings, however large. It is found that the ratio of peak voltage to slide-back voltage, instead of being 1, is larger by an amount that increases noticeably if the "zero" is greater than a fraction of a microamp. To see why this is so, look at Fig. 3. The selected point on the characteristic curve is marked O, giving an anode current of, say, 1 microamp. During the greater part of the signal cycle the current is reduced actually to zero. Therefore, for the meter to read 1 microamp., the average must be maintained by the peak-anode current being very much greater; and for this the signal peak voltage must be materially in excess of the slide-back voltage. As the proportion of the cycle

during which current flows diminishes as the signal voltage increases, this excess is approximately a constant proportion of the whole signal voltage wave.

Even though we may be willing to accept this discrepancy and allow for it in the calibration, the diagram shows that unless one is careful the voltage that can be measured without danger of grid current flowing is limited. Suppose the initial grid bias is 2 volts and the signal peak is even as little as 1 per cent. greater than the slide-back voltage. Then if grid current starts at 1 volt it is obvious that the greatest allowable signal is 100 volts.

If a suitably low "zero" is adopted it appears that a very delicate and expensive indicator is required. Incidentally, if, in the attempt to prevent any risk of its being driven hard off the scale, the emission of the valve is severely restricted, it may be found that there is not enough to allow for the relatively very high current peak shown in Fig. 3; and above a certain signal voltage the error starts to increase rapidly.

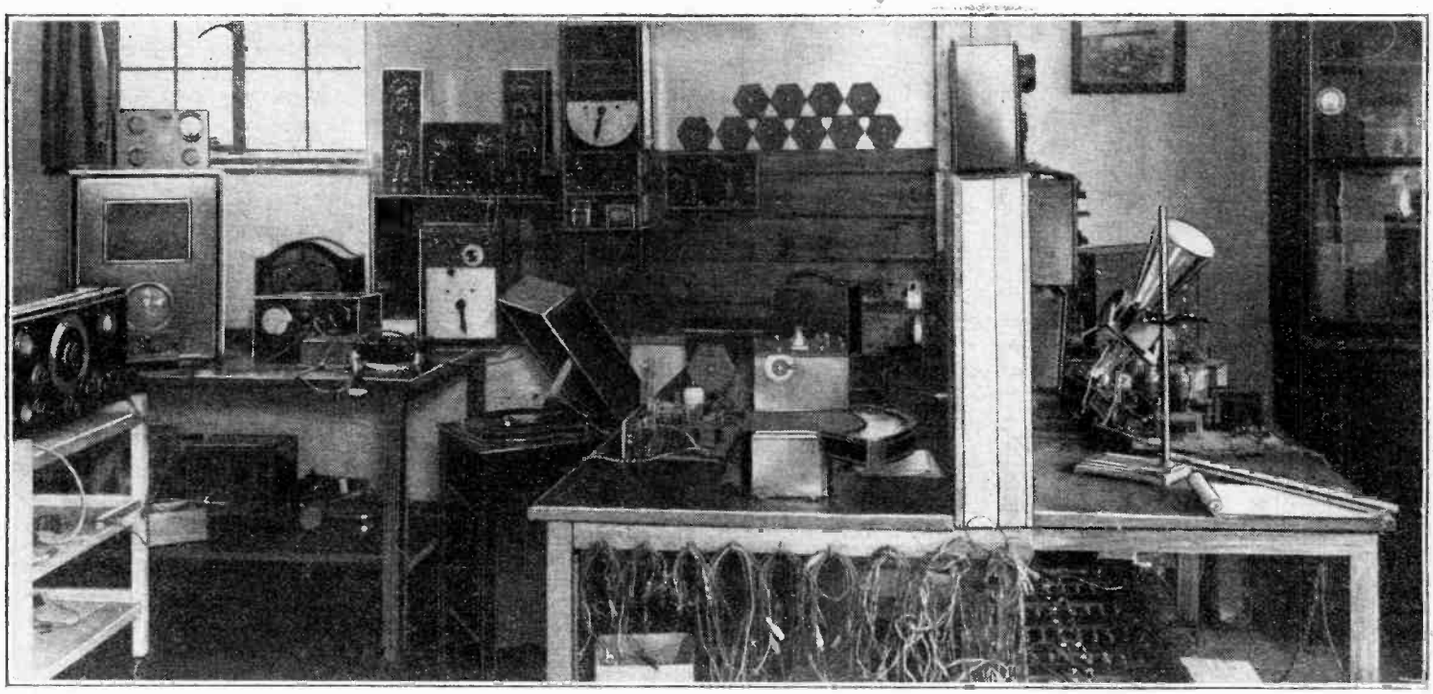
Inexpensive Cathode-Ray Indicator

Fortunately, there is a way out of these troubles. A very sensitive, cheap, portable and undamageable substitute for a delicate microammeter is available in the cathode-ray tuning indicators now in popular use. The Mullard TV4, in particular, is visually sensitive to a change of about 0.1 volt, and if the resistance across its input is the voltmeter valve anode resistance of 1 megohm, this voltage corresponds to 0.1 microamp.

To obtain the maximum sensitivity it is necessary for the control grid of the TV4 to have a small negative bias; but one does not have to do anything about this because the grid current flowing through the megohm applies a bias.

As the "zero" current is so small the usual characteristics of the voltmeter valve do not matter very much, and it is selected chiefly for a very high input impedance at all frequencies. It is an obvious advantage for low input capacity and losses if the grid connection is taken to a top cap on the glass rather than to a pin on the base. This is now becoming general practice for mains-driven pentodes, but a triode is slightly preferable because it has fewer electrodes to feed and to complicate matters. There is a choice of several DC triodes with top grids, and they can be used if the power transformer is provided with a heater winding of appropriate voltage; but as it is convenient to run the heater from the same 4-volt winding as the TV4, a Tungsram HL4g valve is chosen. Alternatively, one could use an American tuning indicator and top-grid triode with 6.3-volt heaters.

To minimise still further the capacity thrown into a radio-frequency circuit when the voltmeter is connected, the connecting leads should be eliminated as far as possible. To bring the whole instrument right up to the test point might be impossible or liable to cause more trouble than it cured, so it is becoming usual to connect the valve as a "probe" at the end of a length of flex carrying low-frequency currents only.



Some of the equipment to be described in this series is seen in this view of the author's laboratory.

While this is a great help in examining very high-frequency circuits, what can be done to reduce the influence of the valve voltmeter is finally limited by the time taken by electrons to cross the space inside the valve. The effect, so far as the external circuit is concerned, is equivalent to a shunt resistance which decreases inversely as the square of the frequency.[2] At 60 Mc/s (5 metres) it may be as low as 5,000 ohms.

For some purposes this may not dis-

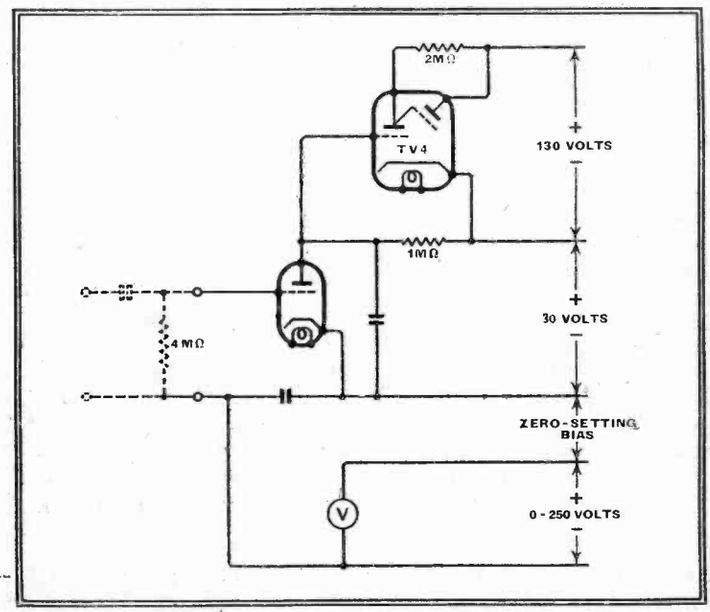


Fig. 4.—Schematic diagram of the slide-back valve voltmeter discussed. The grid input condenser may have a value of 0.01 mfd.

[2] Grid Loss at Ultra-High Frequencies. *The Wireless World*, October 23rd, 1936.

The Home Laboratory—

qualify the instrument entirely; a valve of ordinary construction such as the HL4g mentioned is capable of useful work at an even higher frequency; but to retain satisfactory accuracy and high input impedance the "acorn" type of valve is much to be preferred. Owing to the microscopic clearances between the electrodes it is not advisable to use an "acorn" to measure very high voltages. A peak voltage of 100 on top of an equal slide-back voltage involves a negative grid peak of 200, which is probably quite enough.

Input Circuits

It is often necessary to adopt the alternative input arrangement of Fig. 2 (*b*). The input impedance is inevitably reduced thereby, so the resistance should be high. If very high, much care is needed to protect the valve from small leakages and stray fields, and it is liable to be temporarily paralysed by a surge. A suitable compromise is about 4 megohms. The capacity of the grid condenser depends on the lowest working frequency. It is likely to be required to work at least as low as 50 c/s, and probably to be calibrated at that frequency. At 50 c/s there is 1 per cent. error if RC is 0.023. If R is 4 megohms, C would then be about 0.006 mfd.; a choice of 0.01 mfd. causes rather less error. The object of not making sure of negligible error by using, say, 1 mfd. is, first, that the apparatus would be very sluggish in action, and secondly, that it is essential for the insulation resistance of this condenser to be exceptionally high, such as is likely to be obtained only with good quality mica; and mica condensers over 0.01 mfd. are expensive. Suppose the leakage resistance is 4,000 megohms (exceptionally good for a paper condenser) and the instrument is used to measure a small alternating voltage superimposed on 250 volts DC. Then C and R, acting as a potential divider, puts a DC bias of 0.25 volt on the valve, which would cause a large error.

Now we come to the provision of the slide-back voltage. So long as this consists in finding a battery and a suitable potential divider to control it the process is too troublesome and unsatisfactory to be popular. Presumably, for convenience, the rest of the instrument is to be mains-driven, so, obviously, the slide-back should be also. The voltage to be provided is a matter of individual requirement. Many other sorts of valve voltmeters are limited to a few volts. Seeing that the slide-back type is limited in this direction only by what the valve will stand, and assuming the HL4g or other valve of conventional construction to be used, it is quite safe and sometimes useful to go up to 250 volts peak. It is not a difficult matter, if special occasions require it, to extend this from an external source.

It is most important that precise and steady control of the slide-back voltage should be possible over the whole range. An instrument on the lines suggested is potentially able to discriminate between 250 volts and 250.1, so a jerky control is exasperating. For approximate measurements it would be quite feasible to read the voltage off calibrated potential divider scales without any meter at all; and, where greater accuracy is required, to check the slide-back voltage by means of an externally connected DC voltmeter, applying a correction, if necessary, for the difference between this and the peak signal voltage towards the lower readings. The luxury of a built-in direct-reading instrument scale is not unduly costly, however, because a specially low current movement is not required; the one used in the apparatus to be described later is, in fact, a 5-milliamp. instrument. Even such a robust and inexpensive meter is not definitely improved by applying the full 250 volts when it is switched to the 2.5-volt range, but the vigilance of the operator in this regard can be rendered unnecessary by ganging the range switch and voltage control.

Sometimes a need arises for measuring a DC voltage without any current.[3] The slide-back voltmeter is ideal for the purpose, provided, of course, that connection is made direct to the grid. It is also often very convenient to have in the laboratory such a variable voltage source as the slide-back arrangement comprises.

Omitting details, Fig. 4 shows the general arrangement of what has so far been described, and it can be seen that indicator valve, detector valve and slide-back voltages are all in series. The TV4 is rated at 250 volts, but can be cut down quite successfully to 130; 30 volts is quite enough for the detector valve; and about 260 is needed for the slide-back, to measure 250 and have something in hand. The total is 420. Most of the rectifiers for this voltage are full-wave affairs of high current rating. To simplify matters somewhat the Dario SW1 half-wave valve can be used, for there seems to be no reason why its voltage rating of 400 should not be slightly exceeded.

[3] This absurdly contradictory statement is the penalty that must be endured by readers for refusing to accept the suggested "ZF" in place of "DC."

If a very heavy current were taken at 420 volts it would raise problems of heat dissipation; on the other hand, if the current does not greatly exceed the maximum of 5 mA. required by the DC voltmeter, the operation of the slide-back control is liable to alter the voltages to the valves beyond even the fairly considerable limits that are tolerable with this type of apparatus. To stabilise the voltage an ordinary neon lamp of the "beehive" type is very effective (and cheap).

In the next instalment details will be given of the construction of the valve voltmeter outlined above.

NEWS FROM THE CLUBS

London Transmitting Society

Headquarters: 40, Raeburn Road, Edgware.
Meetings: Thursdays, at 8 p.m.
Hon. Sec.: Mr. G. Yale, 40, Raeburn Road, Edgware.

It has been decided to accept the invitation of the Golders Green Society to co-operate with them in their 40-metre field day on May 1st. Further progress has been made with the building of the new transmitter, and the construction of a communication receiver has been commenced.

Exeter and District Wireless Society

Headquarters: 3, Dix's Field, Exeter.
Meetings: Mondays at 8 p.m.
Hon. Sec.: Mr. W. J. Ching, 9, Sivell Place, Heavitree, Exeter.

On April 4th Mr. H. Ridge gave an interesting lantern lecture entitled "Telegraphs, Wire and Wireless."

Dollis Hill Radio Communication Society

Headquarters: Braincroft Schools, Warren Road, London, N.W.2.
Meetings: Alternate Tuesdays at 8 p.m.
Hon. Sec.: Mr. E. Eldridge, 79, Oxgate Gardens, London, N.W.2.

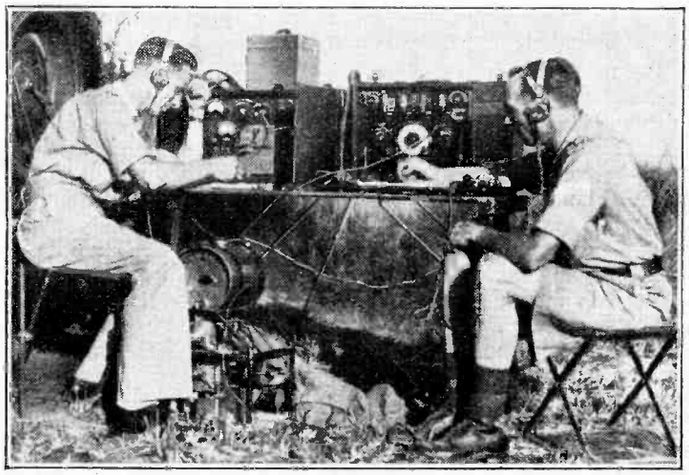
At the general meeting on April 5th, a new committee was elected with Mr. E. Eldridge as hon. secretary. The next meeting will be held on April 26th. A 5-metre section has now been formed and several members can be heard on the air each night after 8 p.m. Reports will be welcomed.

Croydon Radio Society

Headquarters: St. Peter's Hall, Ledbury Road, South Croydon.
Meetings: Tuesdays at 8 p.m.
Hon. Pub. Sec.: Mr. E. L. Cumbers, 14, Campden Road, South Croydon.

The Technical Adviser, on April 5th, Loud Speaker Night, gave a description of the Society's new baffle which he had invented; it can accommodate two loud speakers, either of which can be cut out by a flap.

An interesting evening was spent comparing loud-speaker outputs on actual musical reproduction and by means of a frequency oscillator. This was the last evening of the session. The society will resume its activities on the first Tuesday in October.



ARMY MOBILE WIRELESS UNIT brought into use to relay the results during a recent military competition in India.

Are High-Slope Valves Wanted?

OPTIMUM MUTUAL CONDUCTANCE DEPENDS ON CIRCUIT CONSTANTS

By W. E. BENHAM

THE evolution of radio technique has proceeded, on the whole, more rapidly than has our ability to explain mathematically, or on occasion even qualitatively, the many and complex phenomena which characterise the art. The thermionic valve itself possesses circuit properties no less involved than those of the associated circuits. When in addition it is realised that these circuit properties are of importance both to the internal functioning of the valve and to the design of the external circuit, it will hardly seem surprising that it is usually easier to design circuits round valves than valves round circuits.

It is true, of course, that in many cases valves are designed to meet circuit requirements, and successfully so. But it must not be forgotten in this connection that the circuit engineer, in attempting to design a circuit round a given valve, and finding the valve has certain limitations, may say to the valve manufacturer, "Can't you do this or that?" and so help the valve manufacturer to achieve optimum design. This is more particularly true in the case of a valve which serves a double function, such as a triode-hexode.

As is well known, the limitations of triodes as amplifiers at radio frequencies are due, first, to Miller effect, which causes a large capacity to be thrown across the grid/cathode terminals of the valve, and secondly to the fact that the effective resistance across these terminals may be negative, depending on the anode impedance and on the frequency. In a formula which will be given later the optimum slope of a triode under certain conditions is found to be considerably below that which can be obtained in practice. The same formula when applied to a tetrode or pentode gives an optimum slope which in a typical case is twice that of the triode. These conclusions are of the kind that we also find experimentally, and it may therefore be said that the use for high-slope triodes would seem to be severely limited and that the question of our title can be answered in the affirmative only in the case of valves in which the control grid is well screened from the anode.

Now although the above facts concerning triodes and pentodes are fully appreciated in a qualitative sense by the majority of radio experimenters, considerable mystery as to the exact mechanism at work still exists. For example, it is popularly supposed that the phenomenon of electron damping is important at very high frequencies only. It is, however, important at even the lowest radio frequencies—not in its damping effect on the input signal, but in another connection altogether.

In order to understand where previous theories went astray it is necessary to recall the out-of-date but still very prevalent remark to the effect that the valve consumes no power from the input circuit and thus acts as an amplifier of voltage, and not of power. This notion was first dispelled by the discovery that, at medium and high frequencies, the effect of the anode circuit impedance made itself apparent across the input terminals of the valve to an extent depending on the grid/anode capacity and the degree of amplification taking place. The introduction of the screen grid removed the great majority of such feedback, and the old notion was revived. In other words, the screen grid and pentode valves were supposed to consume no power from the input circuit. With the appearance of papers on transit time theory a modification in this view took place, but only for high-frequency applications was it considered necessary to include across the grid/cathode terminals a resistance, the value of which varied inversely as the product of the square of the frequency and the mutual conductance. The value of this "electron loading loss" resistance works out so high at medium-wave frequencies that its damping effect on the input circuit is quite negligible, and as this point is of major practical importance it is perhaps, not unnatural that any other possible effect resulting from the presence of this admittedly high resistance has not hitherto been considered.

THE author suggests that early misconceptions of valve action have not yet been entirely dispelled and goes on to explain how the optimum valve slope for any particular circuit depends intimately on the constants of that circuit

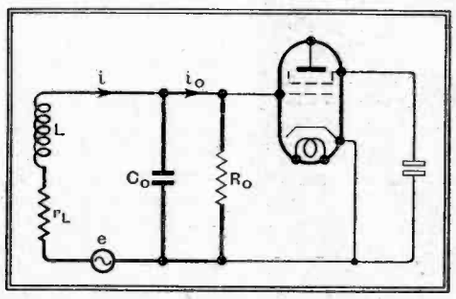


Fig. 1.—Equivalent valve input circuit.

In Fig. 1 we show a generator e corresponding to some radio frequency voltage picked up by the coil L, a resistance r_L which represents losses in the coil and associated eddy current and dielectric losses appertaining to the input circuit excluding valve, a capacity C_o in parallel with (e, L, r_L) and a resistance R_o. The capacity C_o includes the capacity between grid and cathode + screen (N.B. screen is connected to cathode via a large condenser, as shown). The resistance R_o includes the loss due to electron damping and that due to dielectric and other losses inside the valve. To summarise, the generator e, inductance L and resistance r_L are external to the valve, C_o is partly external and partly internal, R_o is entirely internal to the valve. In order to make this as clear as possible the electrodes of the valve are shown in thin line. The by-pass condenser between screen and cathode is also shown in thin line.

Let us now divide the current i from the generator into two parts: a current i_o passing through R_o and a current $(i - i_o)$ passing through C_o. Then if v_o denote the voltage across R_o we have three expressions for v_o corresponding to the three parallel branches. Now if in the circuit of Fig. 1 the resistance R_o and the capacity C_o were independent of the frequency, it is easy to see that the voltage across R_o would become less and less as R_o is reduced from infinity downwards, whether the circuit be tuned to resonance or not.

In reality, however, the resistance R_o is dependent on the frequency and also on the mutual conductance g_m of the valve, while C_o includes the capacity C_{cg} between cathode and grid of the valve, which in turn changes if we make changes in the mutual conductance of the valve.

Interdependence

We thus see that, in studying the effect of changing R_o we are studying also the effect of varying C_o and g_m, and it will be appreciated that the theory becomes complicated.

A solution has, however, been obtained in the case where changes in g_m are made by simultaneous changes in grid/cathode spacing and grid pitch in such a way as to keep the anode current constant. In other words, we will suppose that we

Are High-Slope Valves Wanted?—

have commissioned a valve maker to supply a range of valves of different mutual conductances, but all having the same anode current, and that the changes in mutual conductance from valve to valve were effected by means of changes in grid/cathode spacing and grid pitch only, the position of screen and/or anode remaining unchanged.

We now plug these valves in one after the other, and tune the circuit to resonance each time, observing with a valve voltmeter the voltage developed across the grid/cathode terminals of the valve as a result of a constant injected RF voltage at *e* in Fig. 1. Theory shows that the valve which possesses the slope given by

$$g_m = \frac{3C_1}{20C_o\, r_v} \times 1{,}000 \text{ mA/V} \ldots\ldots (1)$$

will have maximum voltage developed across its input. The value of g_m thus determined will be referred to as the optimum mutual conductance. It is only intended to apply on the basis of a given anode current consumption, as explained above, moreover special valves with auxiliary (secondary emission) cathodes are excluded from this argument. These have much less damping (i.e., higher R_o) for a given g_m, as the current taken from the cathode can be much lower, the anode current being made up largely of secondary electrons. It may, indeed, be that the secondary emission valve will eventually displace ordinary valves, but at the present time the cost of manufacture is the limiting factor. An illuminating article by two members of the Philips Research Laboratory appears in the March issue of *The Wireless Engineer*, in which a mutual conductance of 50 mA/V is quoted as a practical possibility.

We will now seek the optimum mutual conductance of triodes and tetrodes on the basis of our formula (1).

(*a*) Triode. Here C_o will include considerable grid/anode capacity due to Miller effect. Taking $C_o = 10C_1$, we have $g_m = \frac{15}{r_v}$ (mA/V). The resistance r_v may vary between, say, 1 ohm for a very small low-loss coil to several hundred ohms for a pancake coil. Highest value of g_m is seen to be 15 mA/V, lowest considerably below 1 mA/V. It should here be mentioned that the optimum value of g_m as defined in this article is definitely pessimistic, since the anode current change due to a signal v_o is a maximum, not when v_o is a maximum but when $(g_m v_o)$ is a maximum. Theory gives, however, no maximum for $(g_m v_o)$ i.e., as g_m is increased (whether at constant anode current or no) $g_m v_o$ increases indefinitely, until, that is, the valve has become incapable of handling the voltage v_o, as it will do if we go on closing up the grid winding in order to keep the anode current constant. For this reason we have chosen to define our optimum g_m in the way we have.

(*b*) For a tetrode or pentode, the grid/screen capacity can be at least as small as the grid/cathode capacity. Allowing for strays equal to C_1 itself (which, it will be remembered, excludes strays), the smallest value of $\frac{C_o}{C_1}$ which could arise in practice would be about 3 with no tuning condenser and 4 with a tuning condenser set at minimum. Taking $C_o = 5C_1$ as typical, $g_m = \frac{30}{r_v}$ (mA/V), i.e., just double the figure obtained for triodes.

One result which emerges from the theory is that for low-loss coils, particularly small-size low-loss coils, the optimum g_m is higher than for high-loss coils. The physical significance of this result is, roughly speaking, as follows. The apparent resistance of the valve must to some extent "match" that of the input circuit. If we were seeking the transfer of maximum *power* rather than maximum voltage *across* the resistance R_o the matching would have to be perfect, that is to say the dynamic resistance of the tuned circuit must be equal to R_o. We are, however, more interested in maximum voltage since we can measure this more readily.

In conclusion, we may say that analysis shows that the optimum valve slope, or mutual conductance, for use with any particular circuit depends intimately on the constants of the circuit. The theory is too complex to enable general rules to be laid down, but I have tried to give some indication of the main results.

Paris Television Transmitter

SOME TECHNICAL DETAILS

THE new television transmitter at the Eiffel Tower, which was inaugurated by the Minister of French P.T.T. on April 8th, is soon to be one of the most, if not the most, powerful television stations in the world. The transmitter, which has been regularly operating since September, 1937, with reduced power, has recently been transmitting with a power of 15 kW, and will shortly be broadcasting with its peak output of 30 kW.

The aerial is supported by the Eiffel Tower, and is fed by a cable having a total length of 380 metres. Two new studios with the most up-to-date equipment are situated at distances of 5 and 2.5 kilometres from the transmitter, to which they are connected by co-axial cables. These have a characteristic impedance of 71 ohms and a maximum attenuation of 4.8 db per mile at 1 Mc/s, 6.6 db at 3 Mc/s, and 12.6 db at 8 Mc/s.

The entrance to the new Paris television station designed and installed by Le Matériel Téléphonique, French licensee of the International Standard Electric Corporation of New York.

Due to the fact that amplifiers covering wide bands beginning at very low frequencies are difficult to manufacture with satisfactory characteristics, the 0 to 2,500,000 c/s vision signal is impressed on a high-frequency carrier for transmission over the cable. For transmission of the image band a carrier frequency of 5.5 Mc/s is employed, this giving a total transmitted band of 3 Mc/s to 8 Mc/s.

The transmitter is designed to operate on a frequency between 40 and 50 Mc/s (at the moment 46 Mc/s is being used), and has a peak continuous power output of 30 kW. The frequency is maintained constant within narrow limits by a quartz crystal oscillator, which is followed by two doubler stages which raise the frequency to the final carrier value. These doublers are followed by a single valve amplifier, two air-cooled push-pull amplifiers, and three water-cooled push-pull amplifiers, the output of the final stage being coupled through the 56-ohm transmission line to the aerial.

Due to difficulties which are normally present in DC direct-coupled amplifiers, frequencies of 0 to 5 c/s are impressed on a carrier of 3 Mc/s. This modulated carrier is then amplified in five push-pull air-cooled stages to a level of 2 kW, which is rectified in a symmetrical diode circuit. The load resistance of the rectifier is connected through a low-pass filter in series with the grids of the last RF amplifier. The rectified carrier voltage supplies the fixed grid bias for the RF amplifier, and the modulation frequencies modulate the RF amplifier grids. The modulation amplifier employs a large reverse feed-back, which keeps the linear distortion at a low level.

The modulating amplifier for frequencies from 25 to 2,500,000 c/s receives an input of 3 volts peak in 70 ohms from the co-axial cable terminating equipment, and amplifies it to a peak value of about 2,500 volts for modulation of the grid of the final radio-frequency amplifier. The amplifier consists of four air-cooled stages followed by two water-cooled stages, and a modified form of resistance-capacity coupling is used throughout. Due to the extreme limits of the band to be transmitted with small amplitude and phase distortion, care is taken to keep the capacity to earth of the active elements at a minimum. In spite of this, it is essential to operate the valves into a load circuit of low impedance in order to minimise the loss at the higher end of the amplified band.

Television Topics

HARD-VALVE TIME-BASES

LAST week the action of the gas-triode was dealt with and it was said that it is possible to simulate the action of such a valve by one or more evacuated types, such as those generally used in receivers. Such circuits are of considerable importance in television, and one is shown in Fig. 1 which is also of particular value for oscillography when a time-base is required to operate at a higher frequency than is possible with a gas-triode.

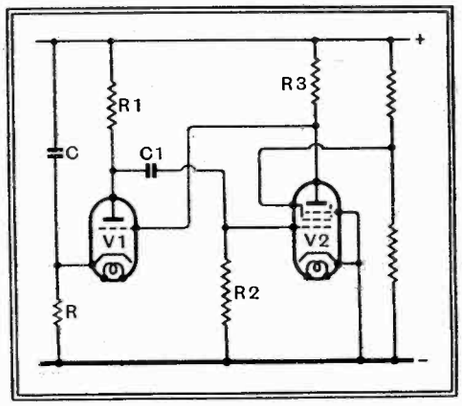


Fig. 1.—A hard-valve time-base which functions extremely well is shown here; V1 is the discharge valve.

This circuit has been described in detail by Puckle[1] and two hard valves are used to act as a gas-triode; the condenser C and resistance R form the charging circuit. In many applications, of course, R is replaced by an RF pentode so that linear charging can be accomplished to voltages approaching that of the HT supply. This is not essential to the operation of the circuit, however, and a resistance can be used with reasonably linearity if the saw-tooth amplitude is kept to about 7 per cent. of the HT voltage, as with other time-bases.

Starting with no charge on C, it is easy to see that V1 has zero anode volts. The grid potential of V2 is substantially zero and this valve passes anode current; consequently there is a voltage drop along R3 and the anode is considerably negative with respect to positive HT. The grid of V1 is joined to the anode of V2 and is consequently also negative with respect to its cathode. V1 is consequently non-conductive. The condenser C then charges through R and its lower plate and with it the cathode of V1 moves negative with respect to positive HT.

The Discharge Valve

Eventually the cathode potential of V1 approaches the grid potential. Anode current then flows in V1 and through R1, causing the anode to become more negative than positive HT. This change of anode potential is communicated to the grid of V2 as a pulse through the coupling C1 R2. This reduces the anode current of V2 and its anode potential rises and with it the grid potential of V1. This in turn increases the current through V1, and V2 is rapidly driven to anode current cut-off and the grid of V1 to a highly positive potential.

Under these conditions V1 has a low resistance and C is rapidly discharged through it and the resistance R1. The cathode potential of V1 then returns towards the potential of the HT line and the current falls. This results in a positive pulse being applied through C1 R2 to the grid of V2 and this pulse renders V2 conductive again with the result that the grid of V1 is driven negative and this valve is made non-conductive in readiness for the next cycle.

The action is exceedingly rapid and gives a quick fly-back, and when properly designed the circuit will operate at very high frequencies. Its main disadvantage is that it needs two valves instead of one, but this is not as great as it seems since hard valves are cheaper than gas-triodes. A minor disadvantage is the necessity for the cathode of V1 being at a potential considerably above earth and at a fluctuating potential. In general, a separate heater winding must be provided for this valve, and if high frequency operation is desired this winding must have a low capacity to earth and the heater wiring must be screened to prevent radiation. Capacity between the cathode and earth is effectively in parallel with C and consequently limits the maximum operating frequency.

Another circuit which is similar in its general operation is shown in Fig. 2. The writer has used this with an American double-triode of the 6A6 type, but separate valves can, of course, be used. V1 is operated as an amplifier and for the best results its anode circuit must be decoupled to the *cathode* by C2 as shown. Both valves have the same negative bias produced by the anode current of V1 flowing through R3.

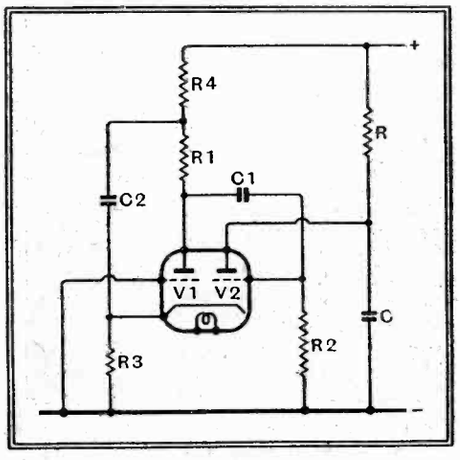


Fig. 2.—Another two-valve arrangement, for which a double-triode can be used, is given in this diagram.

When C is uncharged there is no anode voltage on V2 and this valve passes no current. The condenser charges through R and the anode voltage of V2 rises. When it reaches a certain figure, which depends on the valve characteristics and the grid bias applied from R3, anode current flows and increases the total current through R3 and hence the voltage drop across it. This means that the grid potential of V1 becomes more negative and its anode potential more positive. This change is communicated to the grid of V2 by means of C1 and R2 and drives the grid positive making V2 of low resistance and accelerating the discharge of C.

When the discharge is nearly complete the current falls off and the grid potential of V1 returns to its normal value and the change of anode current provides a negative pulse on V2 which cuts off the anode current and allows C to charge up again.

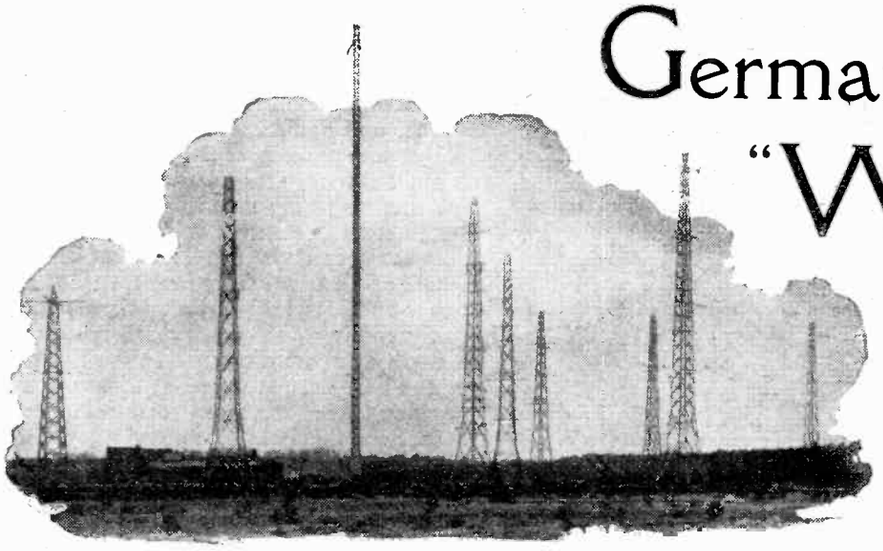
In the writer's experience this circuit does not function well for very small amplitudes of saw-tooth voltage across the condenser but works well for amplitudes of some 40 volts p-p or more. It is not very suitable for low voltage HT supplies, therefore, but should be used with at least 700 volts HT when a linear sweep is needed.

[1] *Journal of the Television Society*, June, 1936.

Technical Instruction

WE have recently examined the prospectus of a correspondence course issued by The British Radio Engineering College. The course is primarily planned for students proposing to enter the servicing and maintenance branches of the industry. Those responsible for its preparation have aimed at producing something to bridge the gap that exists between popular expositions of radio principles and advanced technical books of a mathematical nature.

It has been urged that the training of the majority of those employed in the various technical branches of the industry tends too much towards the superficial or "practical" aspect, and that few have mastered the fundamentals. There can be no doubt that such reproaches have some foundation, and it is good to read that the B.R.E.C. course, though non-mathematical, pays due attention to basic principles, and the earlier lessons aim at imparting a proper foundation on which knowledge of practical applications can best be based. Copies of the prospectus can be obtained from the College at 179, Clapham Road, London, S.W.9.



Germany's "World-Sender"

By Our Berlin Correspondent

ZEESEN CELEBRATES ITS FIFTH BIRTHDAY

WHAT the Deutschlandsender is to listeners in Germany, the German short-wave station is to Germans overseas. Official statistics claim that there are about 18 millions of them, to say nothing of those scattered in various parts of Europe, outside the borders of the recently extended Fatherland. Both stations attained their fifth anniversaries last month.

It is the aim of the German short-wave station to uphold and strengthen the German feelings of those living abroad and to keep them informed of events in the home country. Germany also decided to extend the programmes to foreign listeners and therefore introduced foreign languages. The main purpose of these programmes is to keep the world at large informed as to events in Germany and the German point of view, and also to attract visitors and aid the tourist trade.

Projecting German Ideas

It has been said of the Zeesen station that it broadcasts propaganda. This is correct. It boosts Germany and German ideas and German reactions, but it does not interfere directly with affairs of other countries and only hits back when struck. For instance, on the day of the Jewish boycott in Berlin, on April 1st, 1933, the day of the short-wave station's first regular programme to America, a well-known German radio writer (Hans W. Priwin) spoke to the U.S.A. as a representative of German Jewry from the Zeesen station. This broadcast was intended to counteract the effects of various statements in the foreign Press.

The short space at my disposal does not permit of describing all the varied activities of the station. Listener service is an important factor, and already 65,000 overseas listeners get a free programme booklet from Zeesen every month and thousands of overseas papers reproduce the programmes and photos illustrating them.

In 1933 only 3,000 letters were received. This number reached 50,000 in 1937. I was recently given an opportunity to go through some of these and have received permission to reproduce some of the remarks.

A listener from British Guiana reports good reception of DJQ and DJB between 6 a.m. and 7.30 a.m. E.S.T. He says that reception is even better when it is cold but also remarks that ninety is the usual temperature in the shade.

Another correspondent in Sandakan, North Borneo, is delighted with Zeesen midday concerts, which come rolling in on DJB and DJE and also on DJR. Suva, Fiji, reports "Berlin comes in regularly."

Somebody in Post Moresby, British New Guinea, reports R9 reception on 19 and 16 metres; "reception second to none." He specially enjoys the Hamburg early morning harbour concert.

DJA, DJN and DJQ, notably the latter, are very loud in Akaroa, New Zealand. This listener uses a seven-valve all-wave AC set and would like a pen-friend.

Winnipeg, Canada, listens-in to DJB and DJQ, and also gets DJA and DJC from 5.30-10.45 p.m. E.S.T.

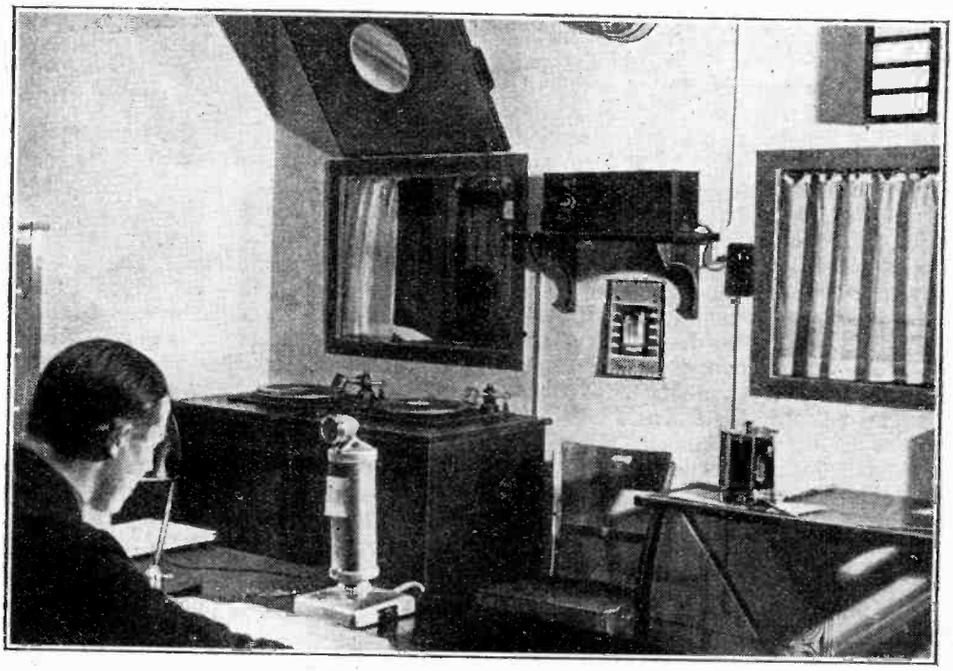
Perhaps the most amusing report comes from a dingo trapper in Central Australia, 280 miles from anywhere. He only sees other white men when he goes once a year to sell his goods (scalps, he calls them). Why should such a man take the trouble to write to Zeesen? The answer is a simple one: he passed a happy time on the Rhine just after the war; and the old link has been revived by the short-wave station.

Technical Troubles

From Mossel Bay, in South Africa, a listener sends personal greetings to one of the announcers. A shift-worker in Belolo, New Guinea, has a 110-volt supply and is worried about his set. From Ottawa the user of a Victor 5-tube 1934 model reports good reception of DJB.

The time seems past when purely technical information was given by listeners. Even the careful questionnaire which the short-wave station sends out to technical listeners is very often returned without details as to aerial used, etc.

One very amusing letter from a German wireless officer on board a tramp asks if he has to pay a licence fee for listening to



In the Berlin studio generally used for broadcasts to North America. Through the sound-proof window facing the announcer is the control room.

Germany's "World-Sender"—

the Zeesen transmissions, even though he only touches Germany every year or so. He also wants to know whether he ought to ask the captain about it and get special permission. One doesn't know if he is pulling our legs or if he seriously thinks that he ought to pay a contribution to Zeesen for the programmes. He reports reception of DJB, P and L in regions of the Pacific where neither the U.S.A. nor the East Asia beam from Zeesen are audible.

Other listeners are delighted with Zeesen's "ever ready to please" system, and only the other day an American family coming over to Berlin seized the opportunity of addressing their friends in the U.S.A. by short wave from Europe. The station has a daily "Greetings to Listeners" feature in each programme zone, and Aunt Maria's long-lost daughter comes to the mike to send greetings, and sometimes one hears the tearful voice of a fond mother wishing her only son a happy birthday away across the water.

The Wireless Industry

A NEW range of Cossor HT batteries and L.T. accumulators is announced. Prices of 120-volt batteries vary from 6s. to 15s. 6d.

The directors of W. T. Henley's Telegraph Works Co., Ltd., have decided to recommend, subject to audit, a final dividend on the ordinary stock of 10 per cent., less income tax, making, with the interim dividend of 5 per cent. paid on October 1st, 1937, 15 per cent. for the year ended December 31st, 1937. They also recommend a cash bonus of 5 per cent., less income tax, for the year.

Since our review of the Ambassador Model 6778 AC went to press, we have been informed by the makers that the price of the console model has been increased to 15 guineas.

The series of Tempovox Radio Receivers, which include a built-in clock, has been extended by the addition of two new models described in leaflets available from British Tempovox, Ltd., Tempovox Works, Holly Road, Hampton Hill, Middlesex. One of the sets is an upright "grandmother" model.

The Ultra High Frequencies

A REVIEW OF CONDITIONS IN 1937

By D. W. HEIGHTMAN

BEFORE describing some of the observations carried out at the writer's station, G6DH, Clacton, Essex, it may be as well to briefly summarise accepted theories of the propagation of high-frequency signals over long distances.

Under the influence of solar radiation the outer rarefied air of the earth's atmosphere becomes ionised, that is, the molecules are split into ions or charged particles. The ions in the atmosphere, in general, increase in number at the higher altitudes, where the air is so rarified that relatively few collisions of ions take place to re-form molecules. Such an atmosphere of ions has the property of bending radio waves. When a signal is transmitted vertically upwards, an echo is received a fraction of a second afterwards, making it possible to calculate the distance it has travelled, assuming the speed. As the frequency of the transmitted signal is increased, say, from one megacycle upward, the distance travelled (i.e., the height) also increases somewhat up to a certain limit, when suddenly the height from which the signal is returned is found to be greatly increased, giving rise to the statement that the ionosphere is formed in separate layers.

It should not be overlooked that a layer may be 200 km. deep. The virtual height of a layer is the height measured by the method previously mentioned. The wave, of course, is probably slowed down in the layer and then reversed in direction without reaching that height, but for convenience the layer is considered as a mirror with a reflecting surface situated at the "virtual height."

A RECORD of daily observations throughout the past year on the highest receivable signal frequency (and hence a measure of the prevailing ionisation density of the E and F layers of the upper atmosphere) is given in the graph which accompanies this article.

Although the presence of many layers has been detected, the two which affect the transmission of radio waves to the greatest extent are known as the E and F layers. The E layer is situated at an average height of 150 km. and the F at least twice that height. Obviously, therefore, a signal bent by the F layer covers a much greater distance. During daylight and particularly during the summer the F layer splits into two separate layers, the outer one being termed the F2 layer. Usually the E layer, having less ionisation density, reflects signals of fairly low frequency and allows signals of higher frequency to pass through it, only to be bent back to earth in the outer F layer.

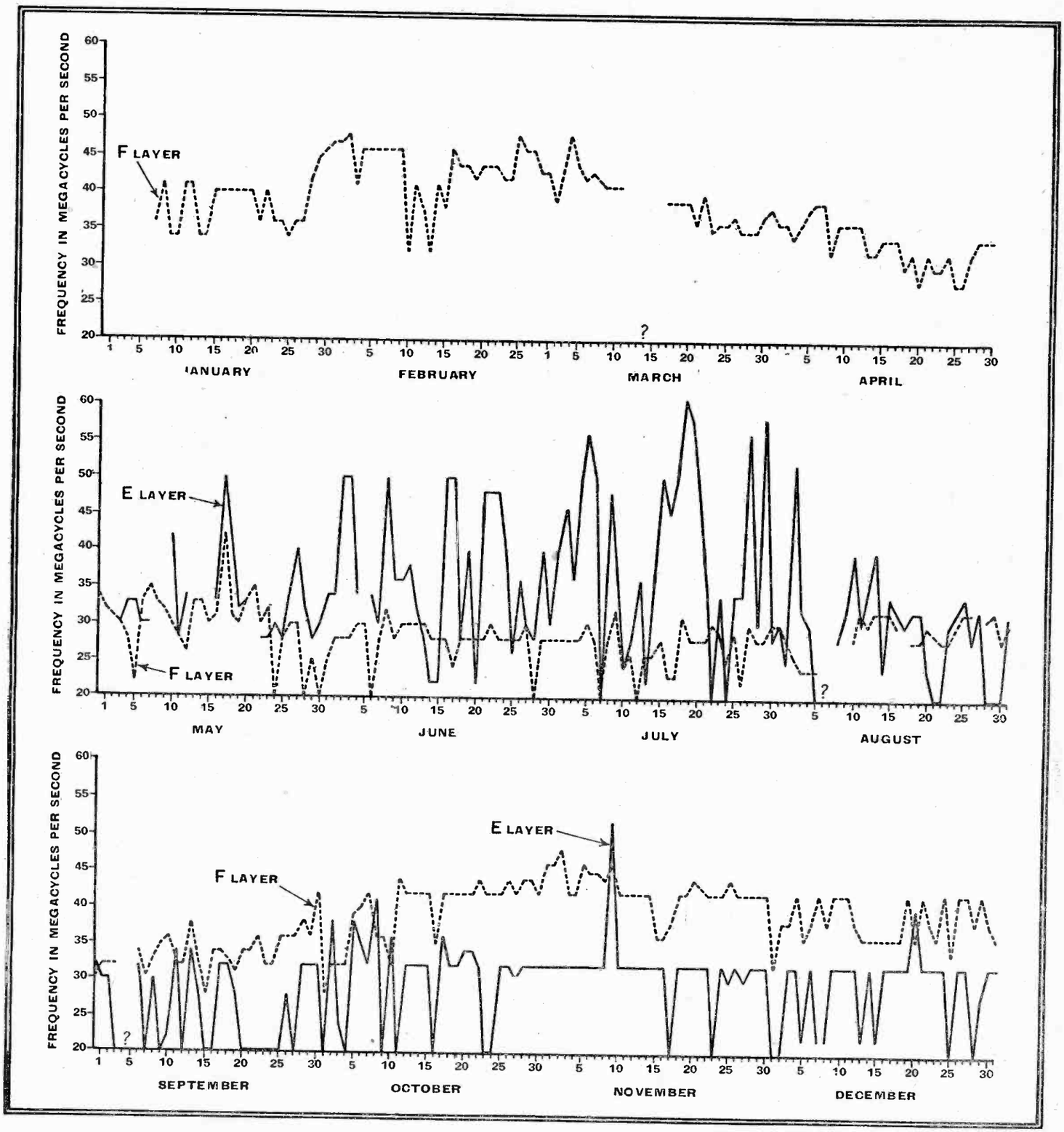
The ionisation density and consequent upper frequency limit of the layers varies considerably from day to day and also with the time of year. Whereas the E layer shows maximum ionisation in mid-summer and minimum in mid-winter, the F layer ionisation is at its greatest at the end of February and again in late October, dropping very much in mid-summer and to a less extent in mid-winter. On some summer days the E layer bends signals of all usual frequencies. Under such conditions long-distance signals are poorly received, since they are returned to earth at short distances before reaching the F layer. It would at first appear that due to the increased solar radiation in summer the F layer ionisation would increase from mid-winter to mid-summer. To some extent it does this from December to February, but then, instead of continuing to increase, begins to drop off. This is the result of some other counteracting effect of the sun on the outer layer which is not yet fully explained.

In order to obtain more information as to the highest frequency on which long-distance contacts were possible, during 1937 the writer daily observed the highest receivable frequency. The results were plotted, and are shown in the accompanying graph. Since the ionisation density is proportional to the frequency of the refracted signals a record of this is also obtained from the graph.

At first only signals from over 1,200 miles were recorded, but from May 1st the signals were divided into two groups, first, those from distances of over 1,200 miles, which are bent in the F layer and shown by a dotted line; secondly, those from distances of up to 800 miles, bent in the E layer and shown by the continuous line. The graph shows very clearly the F layer peaks of February-March and October-November, when long-distance conditions were best. It is interesting to note that 56-Mc/s transmissions from G6DH were heard in U.S.A. during both these periods, also American ultra-high-frequency stations were well received here, W2XHG on 41 Mc/s being particularly good on several days.

With the approach of the summer months it will be seen that the F layer limit dropped to a minimum while the E layer reached its peak ionisation. On several days at that time of the year the intense E layer ionisation was sufficient to refract signals of at least 50 Mc/s, and had there been amateur activity on the 56 Mc/s band at suitable distances, no doubt many contacts would have resulted. This fact is borne out by the good results obtained by American amateurs last summer, when many long-distance contacts took place over ranges of between 500 and 1,000 miles. Such contacts are generally fairly localised geographically, and as the signals are bent in the E layer the distances covered are not much more than 1,000 miles. On July 18th signals were heard up to 61 Mc/s, the highest frequency received during the year.

It should not be overlooked that the graphs show the upper frequency limit on

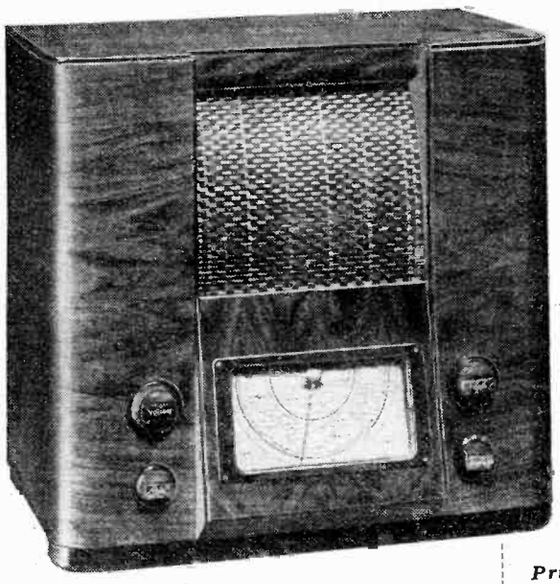


Daily upper frequency limits of reception for 1937. The dotted line relates to reception at distances of over 1,200 miles of signals bent by the F layer, while the full line refers to short-distance reception of signals affected by the E layer. Periods during which no observations were made are indicated by question marks.

any particular day and for all directions. The practical working limits would, of course, be somewhat less than the values shown. On days when fade-outs occur the F layer limit may be high for, say, signals from easterly directions, yet low for westerly directions. During abnormal activity there is an emission of particles from the sun which has the effect of neutralising the outer F layer ionisation so that the upper frequency limit falls much below normal. The shower of particles is apparently bent by the earth's magnetic field and arrives chiefly at the Polar regions, consequently the circuits most affected are those north of east or west, such as, for instance, to U.S.A. or Canada. At such times the writer has often observed the reception of a peculiar radiation, mostly on frequencies over 20 Mc/s, which on a receiver takes the form of a smooth though loud "hissing" sound. This is presumably caused by the arrival of charged particles on the aerial.

It is interesting to note that observations this year so far[1] indicate a considerable drop in the upper frequency limit; apparently, therefore, the winter period of 1936/37 was the peak one for the ultra-high frequencies.

[1] This was written at the beginning of March.—ED.



H.M.V. MODEL 653

Good Quality of Reproduction from an Inexpensive Table Model

FEATURES. ***Waveranges*—(1)** *13.5-50 metres. (2) 195-580 metres. (3) 1,000-2,000 metres.* ***Circuit*—** *Heptode frequency changer—tetrode IF amplifier — double-diode-triode second detector—tetrode output valve. Full-wave valve rectifier.* ***Controls*—** *(1) Tuning. (2) Volume and on-off switch. (3) Waverange. (4) Tone.* ***Price*** *— 10½ guineas.* ***Makers*** *— The Gramophone Co., Ltd., 98-108, Clerkenwell Road, London, E.C.1.*

PRODUCED specifically to meet the demand for an AC all-wave receiver at a somewhat lower price than the cheapest of the Olympia show models, the Model 653 is, nevertheless, a characteristic H.M.V. product and one which will ably represent the firm's work in the markets for which it is intended.

There are three wavebands, and it is worthy of note that there is no curtailment of the short-wave range, which goes down to approximately 13 metres. The superheterodyne circuit comprises four valves, the first of which, a heptode frequency changer, is preceded by a single tuned aerial circuit on all three wavebands. The coupling is inductive, and iron-cored coils are used on medium and long waves. On short waves the coupling to the aerial is capacitative.

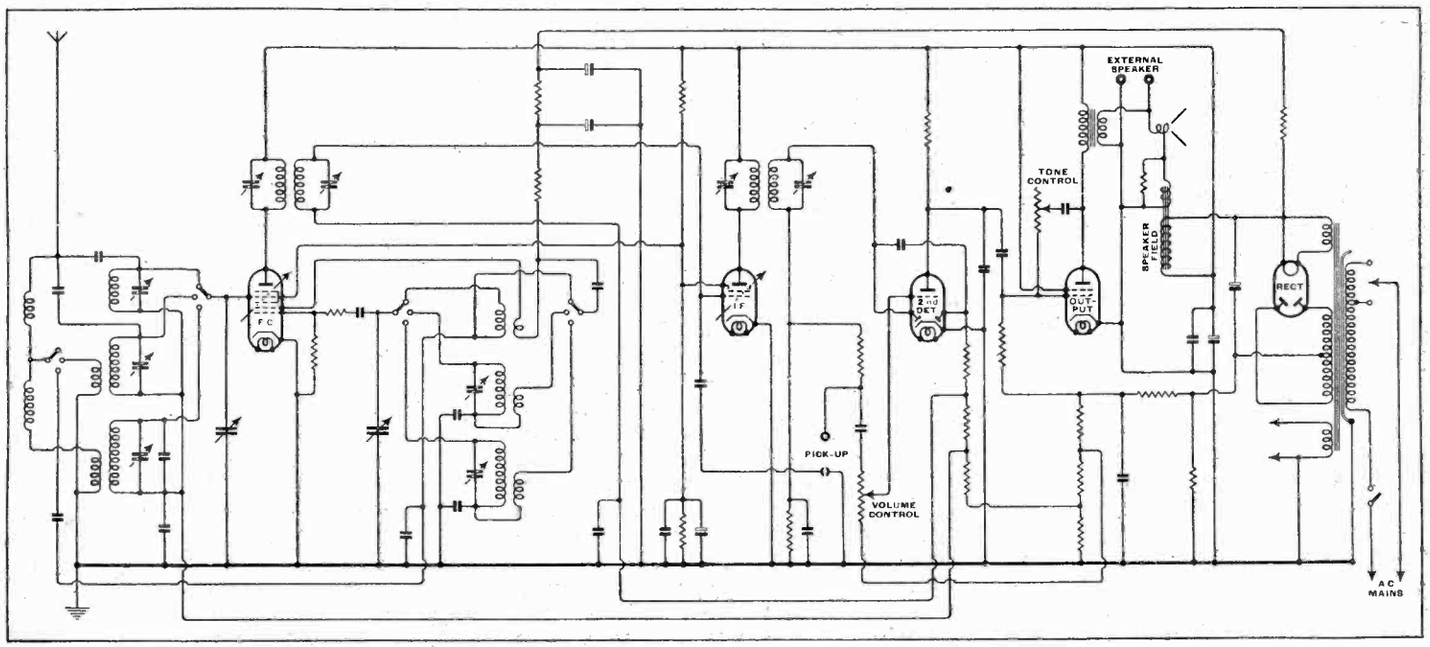
Part of the aerial primary circuit is used on long waves as a low-pass filter to prevent break-through of interference from, and whistles generated by, medium-wave stations. Iron-cored transformers are used in the band-pass filters associated with the IF stage, which makes use of an RF tetrode valve. A double-diode-triode second detector is arranged as usual for AVC rectification and first-stage AF amplification. A pick-up may be connected in the grid circuit of the triode, and the volume control operates on both radio and gramophone. When the pick-up plug is inserted a capacity is automatically connected across the grid circuit of the IF amplifier to suppress radio interference.

The output valve, which is a beam tetrode, is resistance-coupled to the preceding stage. The power supply circuits follow conventional practice, and it is interesting to note in a receiver of this price that an electrostatic screen has been incorporated between the primary and secondary windings of the mains transformer. This refinement, together with the precautions which have been taken to screen completely the radio frequency tuned circuits as a separate unit, accounts for the low level of background noise which is a characteristic of the performance.

This is a comfortable set from the operator's point of view. Tuning, volume, and tone controls are light and smooth, the waverange switch is positive, and the control knob has a well-shaped finger grip giving ample leverage. Above all, the dial can be read at a glance from any position. It is remarkable what an improvement the few degrees of projection makes over the conventional vertical end recessed dial.

Tuning Control

The desirability of giving the short-wave range the longest possible scale has been appreciated, and, as a result, the recognised broadcast bands, which are each marked with arbitrary graduations, are not too cramped. A subsidiary vernier scale concentric with the main tuning pointer rotates nine times for a full traverse of the dial, and not only provides a means of accurately logging stations, but is a valuable visual aid to final adjustments. The single-ratio reduction gear is naturally a compromise between the requirements of the three wavebands, but the



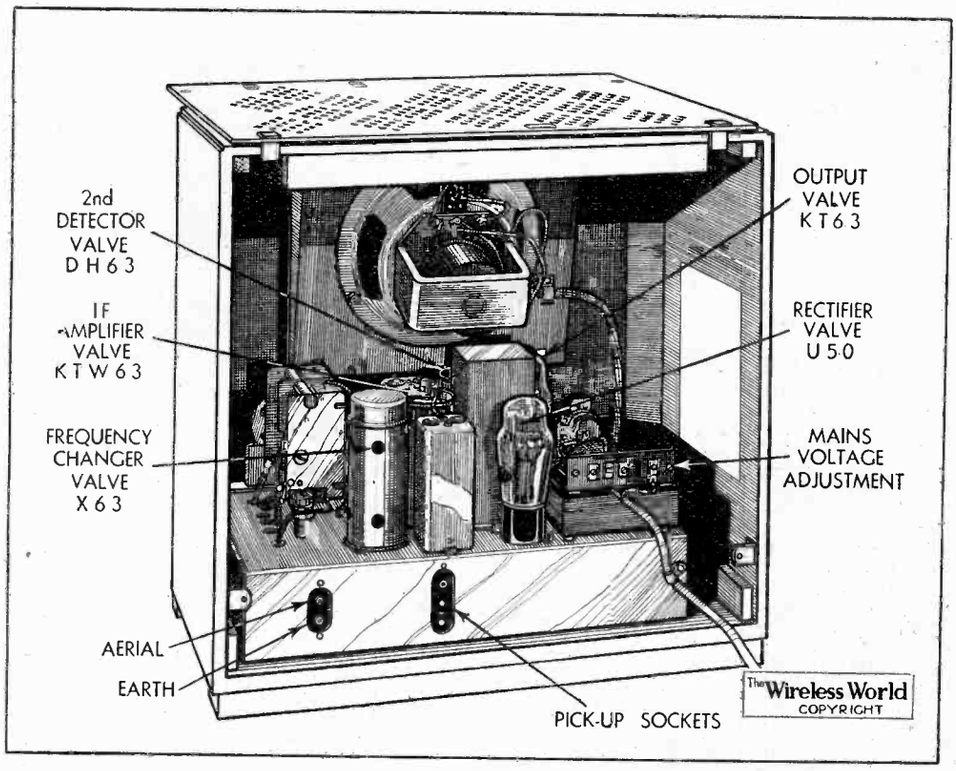
Complete circuit diagram. Tetrode valves are used in the IF and output stages and the tone control is arranged to give some measure of negative feed back.

bias is, if anything, towards short waves, and it is not unduly critical on this range.

The signal-to-noise ratio is very good indeed, and microphony has been kept well under control so that the receiver can be worked always at maximum efficiency. Magnification is uniformly high from 45 down to the bottom end of the scale, and tails off only slightly towards 50 metres.

On medium waves the sensitivity is exceptionally well maintained at the extreme ends of the range, and a crisp and clear-cut performance is obtained alike on local and distant stations. Fécamp on its new low wavelength requires the volume control to prevent overloading. The selectivity, too, is clean and gives a decisive cut-off outside one channel on either side of London Regional at 15 miles.

The long-wave selectivity does not quite fulfil the expectation raised by the medium-wave performance, and the Deutschlandsender carries a background of sideband interference from both Droitwich and Radio Paris. There is no fault to find, however, with the sensitivity on this range, and the only self-generated whistle in the set, which appears just below 1,400 metres, is merely incipient and would pass unnoticed nine times out of ten.


2nd DETECTOR VALVE D H 6 3
IF AMPLIFIER VALVE K T W 6 3
FREQUENCY CHANGER VALVE X 6 3
AERIAL
EARTH
PICK-UP SOCKETS
OUTPUT VALVE K T 6 3
RECTIFIER VALVE U 5 0
MAINS VOLTAGE ADJUSTMENT
The Wireless World COPYRIGHT

The perforated back panel is fitted with leather hinges and folds over on top of the cabinet. Note the size of field magnet in relation to the loud speaker cone diameter.

An Efficient Speaker

Good as is the radio performance of this set, it is the quality of reproduction which will do most to establish its reputation. Crisp transient response and exceptional clarity on all types of transmission are its chief characteristics. The bass response has been skilfully managed, for it easily takes in the tympani and double basses of the orchestra without investing speech with hollowness unless the volume is turned up to an unnatural level. Occasionally there is evidence of excessive top, but as fully three-quarters of the tone control is used up before the top cut is at all drastic, the balance can in all circumstances be adjusted with nicety.

The reproduction from this set will prove a thorn in the side of those who hold that a large-diameter speaker is necessary for good quality. The effective diameter of the cone is little more than 5 inches, but it was observed that the periphery of the seamless paper cone was thinned considerably to reduce the restoring force and lower the natural period. Doubtless the acoustic properties of the cabinet have been taken into account in deciding on the shape of the response curve, but, whatever the means, the result gives no clue to the size of the moving-coil unit.

The sub-baffle upon which the loud speaker is mounted is inclined, and the front is protected by a woven metal grille. There are no external loud speaker sockets, but soldered connection may be made to the speech coil tags for an extension speaker if desired. The impedance should be of the order of 3.5 or 4 ohms.

The chassis is of cadmium-plated steel and is cross-braced at the ends to give rigidity. Similarly the walnut cabinet is designed to afford the maximum stiffness without wasting material.

In conclusion, a word in praise of the leather strap hinges for the back panel, arranged so that it may be turned over on to the top of the cabinet while replacing valves or making adjustments.

Television Programmes

An hour's special film transmission intended for the Industry only, will be given from 11 a.m. to 12 noon, each weekday.

Vision	Sound
45 Mc/s.	41.5 Mc/s

THURSDAY, APRIL 21st.

3, Relay from the Television Studio at the Ideal Home Exhibition. **3.10,** Starlight. **3.20,** Gaumont-British News. **3.30,** 139th edition of Picture Page.

9, From the Ideal Home Exhibition. **9.10,** Starlight. **9.20,** British Movietonews. **9.30,** 140th edition of Picture Page. **10,** News Bulletin.

FRIDAY, APRIL 22nd.

3, "The Gay Lord Quex," play by Arthur W. Pinero. Cast includes Arthur Wontner and D. A. Clarke-Smith. **3.50,** British Movietonews. **4,** Preview.

9, Eve Becke. **9.10,** Zeebrugge. Vice-Admiral Carpenter gives an account of the Zeebrugge Landing. **9.20,** Gaumont-British News. **9.30,** "Anything May Happen"—a Ruritanian Operetta to end Ruritanian Operettas, words and music by MacDougall and MacKinnon. Cast includes Jean Colin and Richard Murdoch. **10.5,** Cartoon Film. **10.10,** Preview. **10.20,** News Bulletin.

SATURDAY, APRIL 23rd.

3, Judo, the art of self-defence. **3.15,** Cartoon Film. **3.20,** In Our Garden, C. H. Middleton. **3.30,** "Oroastus," a Greek tragedy by S. Leacock and "Hamlet the Worker," by Wilfrid Walter.

9, Cabaret, including Ken Harvey, banjoist, and Scott Sanders, comedian. **9.25,** Zeebrugge, a reconstruction in miniature on the Alexandra Palace lake of the night attack on Zeebrugge. **9.45,** British Movietonews. **9.55,** Betty Humby, pianoforte. **10.5,** News Bulletin.

SUNDAY, APRIL 24th.

8.50, News Bulletin. **9.5,** Repetition of Saturday's 9.25 programme. **9.30,** "Acis and Galatea," an operetta by G. F. Handel.

MONDAY, APRIL 25th.

3, David Seth-Smith presents Friends from the Zoo. **3.15,** Gaumont-British News. **3.25,** "The Shadowy Waters," a play by W. B. Yeats.

9, Friends from the Zoo. **9.15,** British Movietonews. **9.25,** The Vic-Wells Ballet in "The Wedding Bouquet." Music by Lord Berners, words by Gertrude Stein. **10,** News Bulletin.

TUESDAY, APRIL 26th.

3, Catch-as-Catch-Can Wrestling. **3.20,** British Movietonews. **3.30,** "Marshal your Facts," with Edward Cooper, Wendy Toye and Charles Heslop.

9, Starlight. **9.10,** "The Smell of the Library," from the story by Michael Arlen. **9.40,** Cartoon Film. **9.45,** Talk on the Budget, by Sir Josiah Stamp. **10,** News Bulletin.

WEDNESDAY, APRIL 27th.

3, Light Entertainment. **3.15,** Gaumont-British News. **3.25,** As on Monday at 9.25 p.m.

9, Starlight. **9.10,** British Movietonews. **9.20,** "There's Always Juliet," a comedy by John van Druten. Cast includes Leonora Corbett and Michael Shepley. **10.15,** News Bulletin.

Books Received

La Télévision. By Marc Chauvièrre. Pp. 267. 244 diagrams. Dunod, 92, Rue Bonaparte, Paris, 6. Price 78 francs, paper cover; 95 francs, board cover.—A book which combines a complete theoretical treatment of television with a good deal of practical information.

How to Overcome Competition. By Herbert N. Carson. Pp. 159. The Efficiency Magazine, Kent House, 87, Regent Street, London, W.1. Price 5s.

NEWS OF

B.B.C. SEEKS ARAB REACTIONS

Listener Research

THE B.B.C. is disappointed because there has been no constructive criticism of the Arabic transmissions from Daventry. The fear is rife at Broadcasting House that only the inarticulate Arabs are listening to them, and if these wished to communicate with the B.B.C. they would have to hire the services of the scribe in the local bazaar. It is now being suggested that small blank recording discs should be sent to the community listening leaders, who would persuade their flock to utter their true opinions regarding the programmes before a recording microphone, the completed discs being shipped to England.

In the meantime, the Corporation is making contact with Moslem leaders, British residents and newspaper editors with a view to obtaining some kind of listener reaction.

The programme builders are also in the dark as regards its Spanish and Portuguese listeners. But does this justify the transmission, on Easter morning, to Arab, Spanish and Portuguese listeners, of the Protestant service from St. Paul's Cathedral?

B.B.C. ADVISES NEWFOUNDLAND

New Station for St. John's

BROADCASTING HOUSE is still the hub of broadcasting throughout the Empire. The engineering department has just sent plans and technical advice to the Government of Newfoundland for the erection of a dual-purpose station at St. John's, which will not only provide programmes of its own for the scattered population, but relay the programmes from Daventry.

Work is about to begin on the station, which is expected to be ready early in 1939.

AMERICAN METHODS FOR BRITISH BROADCASTING?

PARTIAL Americanising of the B.B.C. programme methods, with a speeding up of presentation, may follow the present visit of Mr. R. E. L. Wellington, Assistant Programme Controller, to New York. Mr. Wellington is spending three months in an intensive study of broadcasting at Radio City.

Meanwhile, Mr. Val Gielgud, the Drama Director, is still on tour in America, and will complete a "busman's holiday" by producing G. K. Chesterton's "Lepanto" at Radio City, New York, on April 27th.

CANADIAN BROADCASTING INVESTIGATION

IT was learned during the recent biennial Canadian Parliamentary investigation into broadcasting that the Government, through the Canadian Broadcasting Corporation, places television as a secondary subject to facsimile transmission, and that the right to transmit the latter will be retained by the C.B.C. Members of Parliament also learned that private broadcasting stations are to be more heavily taxed than their annual $50 licence; that the C.B.C. will only continue commercial broadcasting until it completes the erection of at least three more 50-kW stations, two of which are to be erected this year in the Maritime (Atlantic coast) provinces and Western Canada; that eventually private broadcasting stations, of which there are at present seventy-two, will only be allowed to function with a power limit of 1 kilowatt; and that $3,200,000 will be required for the year ending March 31st, 1939, of which $2,700,000 will come from listeners' licences and and the remainder from commercial programmes.

LANCASHIRE MOUNTED POLICEMAN using one of the transmitter-receivers with which the section is now equipped. The transmitter has a power of about 4 watts and a range of two miles. The complete apparatus, which weighs approximately 15 lbs. and is constructed in the Lancashire Constabulary's own workshops, operates on a wavelength of 5 metres.

CHURCH BROADCASTS: TECHNICAL CRITICISM

IT is alleged that the average Variety programme broadcast by the B.B.C. receives far more attention in the matter of presentation than do most broadcast religious services.

The main points of criticism are (a) that too little attention is paid to vocal balance, B.B.C. engineers having no say in the positioning of the choir; (b) that the microphone tends to emphasise singing out of tune, a prevalent fault with choirs; (c) that organs are misused, the tendency being to swamp singers.

The ideal arrangement would be for the Balance and Control Engineer to go into close consultation with the organist and choirmaster before a church broadcast to ensure that, as far as possible, the musical side of the service shall be worthy of the broadcasting medium.

POLICE RADIO IN AUSTRALIA

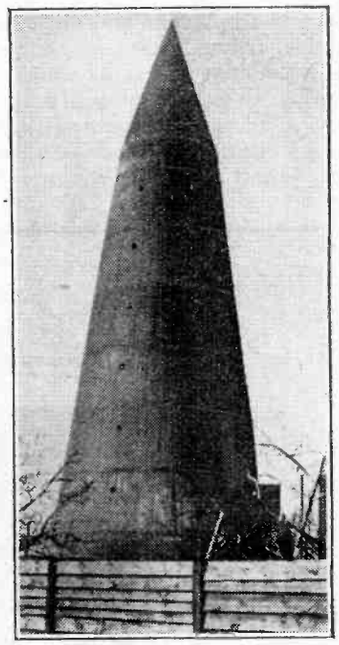
NEW SOUTH WALES now possesses a police radio system of which it can be justly proud. The main transmitter is situated at Sydney, while a subsidiary station is located at Newcastle, about 100 miles north of Sydney. Both stations operate on the same wavelength. The Sydney transmitter's power is rated at 200 watts unmodulated carrier for telephony and 700 watts for CW telegraphy, and that at Newcastle has a power rating of 100 watts unmodulated carrier for telephony.

To overcome the difficulty of electrical interference with reception, a receiving site in a quiet residential area about 7 miles from the main transmitter in Sydney has been chosen. It is equipped with superhets, and the signal from any receiver is fed through a switchboard to the main station by means of direct land line.

Fourteen patrol cars and two launches are fitted with wireless equipment, and the patrol radius from Sydney is 60 miles and from Newcastle 40 miles.

RADIO EQUIPMENT IN LINERS

THE contract for the supply and maintenance of complete wireless equipment for the new Union Castle liner, *Capetown Castle*, has been given to the Marconi Company. Three other vessels of the same company, the *Winchester Castle*, *Carnarvon Castle*, and *Warwick Castle*, are also to be refitted after alterations which are scheduled for this year.



BERLIN A.R.P. SHELTER which is 70ft. high and contains a spiral gallery with accommodation for 300 people, is fitted with loud speakers for the diffusion of music from gramophone records, although there is no technical reason why wireless should not have been used.

The equipment of the *Capetown Castle*, which will also be similar in each of the other vessels, consists of a 2-kilowatt CW/ICW medium- and long-wave transmitter, a 1½-kW short-wave transmitter, and a ¼-kW quenched spark gap emergency set together with receivers covering the whole of the commercial wavelengths. A direction-finder with double loop fixed frame for navigational purposes is being fitted, and transmitters and receivers are to be installed in two lifeboats.

GARDENING TALKS: A PROBLEM

LETTERS to the B.B.C. from listeners in the North have pointed out that Mr. Middleton's weekly gardening talks relate only to gardening conditions in the South of England, where nature's processes are sometimes at least a fortnight in advance. Novocastrians who follow Mr. Middleton's advice and plant out tender seedlings find, too late, that the icy blasts of winter wastes the work of months. It is now suggested that the talks should be recorded for broadcasting to Scotland and the North.

THE WEEK

INDUCTION ON THE TELEPHONE

DURING the last few days telephone subscribers in Worthing have been entertained by snatches from the B.B.C. National programme when they have been "holding on" for long-distance calls. The Post Office states that the trouble is caused by induction from a new line put up by the local Radio Relay Company running parallel to one of their own. The matter could be easily rectified if subscribers were to complain.

GERMAN TELEVISION

THE 441-line equipment in the new Berlin Television studios is undergoing its test period, but it is understood that the transmitter will not be working regularly until June or July. Meanwhile Intendant Nirentz, Programme Director, who is a well-known poet and former film producer in the Propaganda Ministry, continues with spotlight scanning. He has even produced a ballet of six dancers performing in the dark studio in front of the scanning light.

The State Museum in Munich will open a special television show on May 1st. This will remain open to the public until the beginning of October.

INDIAN LINGUA FRANCA

AT the Calcutta Conference of Indian station directors held recently, much time was spent in discussing the question of the diversity of Indian languages. That this question is a very serious one will be realised from the fact that in Bombay there are three languages, besides English, which are widely used, namely, Marathi, Gujarati and Hindustani.

It is pointed out in *The Indian Listener* that it is almost impossible to incorporate a number of languages in one programme, and there is no doubt that ultimately a mixture of Hindi and Urdu will be the lingua franca of India, but in the meantime a committee will be set up to consider a vocabulary for use in broadcasting.

CLANDESTINE TRANSMITTERS ARE POPULAR

FRENCH listeners have been startled by a mystery station which for some days past has been transmitting anti-Government propaganda from 1.15-1.30 p.m. each day. The station, which works on a wavelength of 250 metres, announces itself as Radio National. Similar transmissions are radiated on the 25-metre waveband during the evenings.

Russian listeners have also been subjected to anti-Government transmissions from an unknown station transmitting on 29.9 metres. This station identifies itself with the words, "The Union of Liberators."

It is reported that forty-six arrests have been made in connection with the German clandestine transmitter, whose activities were described in these pages on March 3rd.

FROM ALL QUARTERS

Radio on Belgian Trains

"RADIO-TOURIST" trains are to be introduced on the Belgian State Railways this summer. Broadcast programmes will be picked up, and travellers will also hear gramophone recordings relayed from the brake van and descriptions of the country through which they are passing. Each coach will be fitted with one or more loud speakers.

People's Receiver in Austria

THE Austrian radio industry has undertaken to produce a People's Receiver, with the promise that 60,000 of these will be accepted for sale in Germany, whilst the German radio industry undertakes not to sell their own People's Receiver in Austria before the end of 1939. At the next German Radio Exhibition the Austrian radio industry will have the opportunity of conducting propaganda for the sale of these sets.

Radio Beacons

ACCORDING to the *Lighthouse Service Bulletin* the total number of marine radio beacons in use in the world at the beginning of 1938 was approximately 421, an increase of 41 during the year.

Licence Figures

THE approximate total number of licences in force at the end of March, 1938, was 8,590,750, as compared with 8,127,630 at the end of March, 1937.

German Radio Exhibition

"BROADCASTING the voice of the nations" is the slogan for the German Radio Exhibition, which opens on August 5th and lasts until August 21st.

Ministerial Changes

THE French Minister of Wireless in M. Daladier's Cabinet is M. Jules Julien.

Wireless Appeal

ALTHOUGH Christopher Stone's broadcast appeal on behalf of the British Wireless for the Blind was made as long ago as Christmas Day, occasional gifts continue to arrive. Donations have reached the total of £23,041. Mr. Stone is to appeal on behalf of St. George's Hospital, London, on Sunday.

Interference in the U.S.A.

ELECTRICAL interference in America is not merely troublesome to the short-wave listener but to the police radio systems, most of which operate on the 9-metre waveband. The recently formed National Association for Prevention of Radio Interference is doing good work in exposing perpetrators of this offence.

E.I.B.A.

AT the annual luncheon of the Electrical Industries Benevolent Association the President, Mr. E. E. Sharp, said that he wanted to raise the Association's invested funds to £250,000, and this meant that £190,000 had to be raised this year.

AN ANNOUNCER'S DESK at the Zeesen short-wave headquarters in Adolf Hitler Platz, Berlin. To obviate mistakes the microphone bears a list of the wavelengths and call signs used. Note the control buttons in the foreground; one closes the time signal circuit, the second is for communicating with the control room, the third for the interval signal and the fourth for warning those responsible for the next item that the announcer is about to finish. (See article on p. 355.)

Polyglotic Italy

IT was recently announced by the Minister of Popular Culture in the Italian Chamber of Deputies that there were now transmissions in nineteen languages from the Italian stations.

"Radio Wein"

THE official Austrian programme paper, *Radio Wien*, ceased publication at the end of March.

Si Parla Italiano

THE Hungarian Broadcasting Company has ordered that their announcers should not only be able to understand Italian, but be able to speak it fluently.

Vacancies for Wireless Operators

BIG shipping companies are experiencing a severe shortage of wireless operators. There are no strict age limits imposed upon applicants, whose period of training is about twelve months.

Short-Wave Train Communication

AFTER several months' trial the Norwegian State Railways have equipped goods trains plying between Trondjem and the Swedish frontier with short-wave wireless apparatus which enables the brakeman to establish communication with the engine-driver.

Encouragement for Radio Playwrights

THE French Minister of Posts and Telegraphs has fixed a scale of fees for original works and adaptations for broadcasting. This is intended to be an encouragement for radio playwriters.

Lifeboat Wireless

IT was recently revealed by the Secretary of the Royal National Lifeboat Institution that, out of the 53 boats which could be fitted with wireless, 27 had installations, and before the end of the year it was hoped that another 23 would be similarly equipped.

New Turkish Transmitter

TURKEY is to construct a new medium-wave transmitter of 120 kW and a short-wave transmitter of 20 kW.

Broadcast Advertising

A "CHAMBRE Syndicale de la Publicité Radiophonique" has just been founded in France. It will deal with all matters relating to broadcast advertising.

Verboten

THE erection of poles for aerials on the new housing estates is forbidden by the Peniston (Huddersfield) Urban Council, the opinion of the Council being that indoor aerials are quite satisfactory.

South America is Interested

A SUDDEN increase in the sales of short-wave sets in South America is attributed to the interest taken in the recently inaugurated B.B.C. Spanish Service.

Radio on Bicycles

ACTING on the suggestion of *Haut-Parleur*, wireless manufacturers in France are contemplating the large scale production of lightweight wireless receivers, designed to work on bicycles.

UNBIASED

BY

FREE GRID

Cheese-paring Economy at the Palace

IN spite of my frequent criticisms of the B.B.C.'s pettifogging pigheadedness and irritating irrationalism in many matters, I have hitherto held them in very high esteem for their technical ability, but I am sorry to say that as a result of certain happenings last week I have been compelled, pending an explanation by the B.B.C., to modify my opinion.

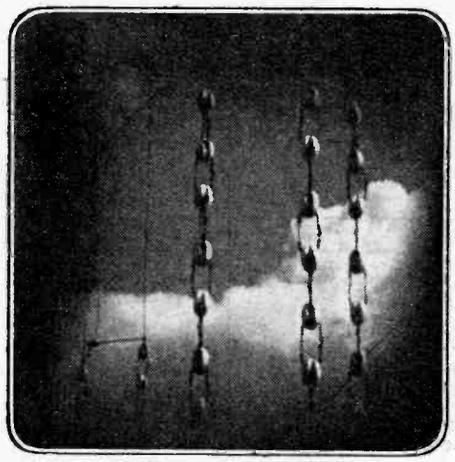
It so happened that I made a special journey up the hill to the Alexandra Palace the other day armed with a pair of binoculars, the object of my visit being to make a close inspection of the television aerials with a view to carrying out certain improvements in the one I use at home. When I focused my glasses on the top of the aerial mast I could scarcely believe my eyes at the frightening vision which met my gaze. When I had investigated a little further, however, I found that I had been looking at a greatly enlarged vision of an insect which had somehow or other got between the lenses.

Having duly removed the offending insect I again levelled my glasses at the mast but received another rude shock and naturally at once suspected my glasses again and proceeded to dissect them. Unfortunately, I carried the latter process a little too far and it has cost me a pretty penny to have them reassembled by an optician for which, in view of what I am about to relate, I think the B.B.C. ought in common justice to pay. When I had received the glasses back and made a fresh journey to the Palace I was amazed to find that the sight which had caused me to dissect the binoculars on the previous occasion was still in evidence.

For a moment I was completely nonplussed. I did not like to blame my binoculars again, although I could scarcely credit that that which I saw was there in actual fact. Suddenly, however, I recollected the famous words of wisdom uttered by Mr. Gladstone in 1878 to the effect that the camera cannot lie and I hurried home in a fast car to collect my camera and a good telephoto lens. The result is that, as you see by the photograph I took and which I reproduce herewith, my worst suspicions were confirmed.

It will be at once painfully obvious to you fellows that the B.B.C. Technical Bigwigs do not even know the correct method of connecting up simple egg insulators. Of course, I am fully aware of the fact that they will save their face by replying that this method of using the insulators was adopted for a very important technical reason, namely, to obtain low capacity. Surely, however, a mighty corporation like the B.B.C. can design and get made for them special low-capacity insulators of the proper type instead of trying to save a few miserable pence by sending the boy round to the local sixpenny stores, which is obviously what they have done in this case.

It is not only the glaring technical unsoundness of this method which is worrying me, however, as there is a far more serious aspect of the matter, and that is the danger to the public if the insulators break under the mechanical strain imposed on them during a gale. With the proper method of connection this possibility is duly taken care of but, as things are, in the event of a breakdown in a high wind innocent citizens are likely to be struck by flying fragments of aerial wire. I sincerely trust that some responsible person at the Alexandra Palace will take the necessary steps to remedy this state of affairs without delay.



"My worst suspicions were confirmed."

Camera or Televisor?

I WONDER if it is possible before it is too late to register a strong protest against the use of the word "camera" in connection with television. Recently I raised the question personally with some of the bigwigs of television only to receive the rather lame excuse that it is a highly convenient word. Convenient or not, I know from my own experience that it is having a very baneful effect from the point of view of encouraging Mr. and Mrs. Everyman to become really television-minded.

Hearing the word so often in connection with television, ordinary citizens are prone to come to the conclusion that there is not much in television after all, as it is merely some sort of glorified cinema film transmission. Probably they are assisted in this wrong attitude of mind by some hazy recollection of hearing at some time or another of the old "delayed-film" system. Even quite knowledgeable people are, however, apt to think that all the television programmes, more especially plays, are made up of film transmissions instead of flesh-and-blood performances.

As for an alternative word which is easily remembered and comes readily to the tongue, what could be better than the word "televisor"? Is it too late to drag this valuable word from its association with the receiving end of the business? A televisor is surely a thing that televises, and this exactly describes the function of the so-called television camera. Failing the adoption of this word, one could borrow from the world of sound broadcasting and use the word which is so obvious a companion-in-arms to the word "microphone," namely, "microvisor."

Old Friends Are Best

I MUST ask you to excuse me if these rough notes of mine do not seem quite up to their normal technical standard this week, but as a matter of fact I have received a very severe shock and I am still feeling somewhat weak and ill in consequence. My feelings must, I suppose, be somewhat akin to those experienced by the great and learned savants of the world when Galileo first announced that the earth was round, thus destroying at a single blow the very foundations upon which all their scientific work had been built up.

In my case it is not a question of the world's roundness but something fully as important, namely, Ohm's Law, which I have hitherto believed was as strong and immovable as the proverbial laws of the Medes and Persians were supposed to be. It is very hard to give up one's cherished illusions, and I must confess that when I read in *The Wireless World* recently that Ohm's Law "crumbles into loose sand where rectifiers are concerned" I was sorely tempted to sit down and write a strongly worded letter to the Editor demanding the public renunciation of this heresy.

Saner counsels prevailed, however, and I realised that I should probably get myself involved in intricate mathematical formulæ which would ill befit my somewhat humble position in the technical world. My irrational self, however, cannot help feeling a sneaking regard for that stalwart friend of my youth, Old Man Ohm, and although I have, needless to say, now thrown him overboard, I feel that I cannot calmly watch him drowning without making some attempt to save him. I am, therefore, thinking of forming an "Ohm's Law Protection Society," and I shall be very glad to hear from any of you who would like to join me, more especially the more technically-minded of you who would be prepared to enter the technical jousts in an old friend's favour.

Why Maths ?

By "CATHODE RAY"

AT school we had a geometry master who, when he asked a boy to prove that certain triangles were similar (or whatever rot he happened to be teaching at the time), would draw them on the board as shown on this page, if the boy's name happened to be Watson. When it came to my turn, of course, the triangles were C.A.T., H.O.D.

Apart from adding a welcome touch of pleasantry to the schoolroom, this practice helped to emphasise that the truth of a mathematical statement does not depend on the letters or symbols used to express it. Some people are frightened of algebra and trig., and things like that because the idea of "doing sums" with letters seems to involve brain-work of an almost occult order. Actually, the letters and things are there to make the work easier. I am sometimes amused by the long-winded and clumsy ways in which things are sometimes explained by non-mathematical persons, when they could be given clearly and concisely in a simple formula. Even ordinary language would sometimes be clearer if some of the conventions of mathematics were used. They would make quite plain the differences between "a small red (deer hunter)," "a small (red deer) hunter," and "a (small red deer) hunter" by showing which words qualify which.

The person who shudders and hurriedly closes any book or paper in which mathematical symbols appear is in this state of shyness probably because unwise methods of school teaching gave him the impression that maths was beyond him. When page after page is covered with symbols, there are two explanations: either they are necessary, in which case the matter *is* beyond the ordinary reader; or they are not necessary, in which case it is fit for nobody. The latter class of work, presumably written to gain a reputation for learning, not only obscures the subject treated, but gains mathematics a bad reputation.

Mathematicians—and Others

I suppose there are people who can read through pages of mathematical work as easily and naturally as they do ordinary writing, but as I am not one of them there need be no fear of my introducing that sort of thing here, necessary though it may be in its place. If a writer *cannot* put what he is getting at into plain words, the chances are that he is not at all clear about it himself. Faraday was perhaps the greatest of electrical scientists, and his writing is practically non-mathematical. On the other hand, we wouldn't have got far in radio if it hadn't been for mathematicians like Clark Maxwell.

But because some mathematical work is completely and utterly beyond the ordinary reader, that is not to say that everything remotely resembling it is to be shunned like the plague. By steering clear of every trace of x and y and θ and π, one is actually making things more difficult for oneself. These letters and other symbols are just a quick, easy way of saying things, and can be made use of by anybody who can do elementary arithmetic.

One of the simplest and most helpful uses of letters in place of numbers is the *formula*. This is just an abbreviated method of telling one what to do in order to work out a result from particulars given.

x and y Sometimes Make Things Easier

To find the number of square yards of lino to cover a rectangular floor it is necessary to multiply the number of yards in the length of the floor by the number of yards in the breadth. This is usually stated as "multiply the length by the breadth," but, of course, that is nonsense unless it is understood to be an abbreviated form of the previous statement. It could be abbreviated still more by adopting a semi-mathematical appearance:—

$$\text{area} = \text{length} \times \text{breadth}.$$

Having got so far, one might as well write it still more quickly:—

$$a = l \times b, \text{ or } a = lb,$$

which is the stage at which some readers begin to take fright. The only reason why the letters a, l and b were selected is that they remind one of the things they stand for. Apart from that there is no reason why the same truth should not be written as:—

$$x = yz,$$

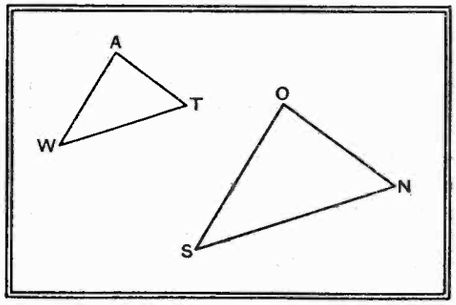
or even:—

$$\alpha = \beta\gamma,$$

so long as one knows what these symbols mean. As there are only 26 letters in our alphabet, and fewer still in the Greek, it is not feasible to allocate any one of them permanently, be it a or x or α, to mean the number of square yards of lino required to cover a floor. One letter that does seem to have a fixed meaning is π, representing the ratio of circumference to diameter of a circle. This is a particularly good example of abbreviation, because to write down the number represented by π it would be necessary to keep on literally for ever. It is 3.1415926535. . . . etc., etc. The first three or four decimal places are near enough for most purposes.

Apart from π, if the meanings of the letters are not given, one has to decide what they are likely to mean in that particular connection. If the subject is valves (the wireless sort, not steam engine or bicycle tyre) it can be assumed that μ stands for *amplification factor*. But if iron cores for transformers are being discussed, μ should be read as *permeability*. Or if it comes before a big F (farad) it is an abbreviation for micro—meaning *one millionth*. Talking about a millionth, one often comes across it written as 10^{-6}. It is easier to see that 2×10^{-6} is two millionths than if it were written 0.000002. The small number above the 10 indicates the number of places the decimal point is to be shifted, − indicating a movement to the left, and + (or nothing) meaning a movement to the right. For example, 3.72×10^{12} is 3,720,000,000,000; and 23.94×10^{-9} is 0.00000002394. That is quite sensible, surely, for saving time and making things clearer? In radio one so often comes across very small or very large numbers, that this sort of shorthand is very useful.

It is true that there is occasionally some risk of confusion through using letters, and they ought to be chosen and used with care, but for common purposes in radio there are comparatively few to learn. What is, perhaps, liable to be muddling—though it doesn't seem to be so in practice—is that letters are used in different ways. The way I have been discussing is as a substitute or abbreviation for some number that is filled in when it is known (as in the lino measurements). There is V or v or E or e for a voltage (the E is derived from electromotive force), and C for capacity, and L for inductance, and so on. Unless anything is said to the contrary, these quantities must be understood to be in volts, farads, henrys, etc., respectively. $I = \frac{E}{R}$ is a familiar statement (Ohm's law); when one has a current passing through a resistance there is a voltage across the resistance, and if any two of these are known numerically, the above formula explains how to find the third. It holds good for amperes, ohms



One way of selecting letters for diagrams.

Why Maths?—

and volts; but if it is to apply for milliamps it is necessary to alter it to

$$I=\frac{1{,}000E}{R}.$$

Another use of letters is as an abbreviation, not for a number, as above, but for the name of something. Thus, while I represents a number of amperes, A stands for "ampere." If in a particular case a resistance of 50 ohms is applied to the 200-volt mains, by substituting these numbers (or *values*) in the above equation, I works out to 4 amperes, which can be written briefly as I=4A. This is *not* a formula, or equation, stating that the current is equal to 4 multiplied by some mysterious quantity A.

If the resistance had been 50,000 ohms, the current would have been 4-thousandth of an amp, or 0.004A; but here m as an abbreviation for "thousandth" becomes useful, and this small current is preferably written as 4 mA, read as "4 milliamps." The only occasions when people show a curious reluctance to save themselves the trouble of saying or writing a lot of preliminary noughts is when small capacities are mentioned. Personally, I find "50 $\mu\mu$F" much easier than "0.00005 μF."

Reference Letters

Still another use for letters, and one that has even less right to be considered "mathematical," is simply as a label, for example, when referring to the resistor R2 in a diagram. The little 2 has no mathematical significance (such as it would have if it were written R^2), but as there are usually several resistors in a diagram it is necessary to number them. R is an obvious choice for resistor, but instead of making a coil C (because that is already booked by condensers or capacities) it is customary to borrow the letter used in formulæ to stand for the value of inductance, L. This letter, therefore, may refer to a coil in a circuit diagram, or the number of henrys inductance of that coil, or both.

One reason why there is less confusion in the use of letters than might be expected is because even apart from those letters that have definite meanings attached to them, there is general agreement, for example, that x and y and z shall be reserved chiefly for variable quantities, and a, b and c for fixed quantities; and, as another example, if any letter such as f represents a quantity, a very small increase or decrease in that quantity is written δf (or sometimes Δf). Both these Greek letters are "delta," one being the small letter and the other the capital, and they mean "difference." The letter f may stand for the frequency of an oscillator tuned by a capacity C, and if the capacity is shifted very slightly by an amount δC the frequency alters by a small amount δf. Although it is not true to say that $C=2f$, if δC and δf are so small as to be infinitesimal it is true to say $\delta C=2\delta f$, or in other words, the frequency changes half as fast as the capacity. Oddly enough, this simple thought is part of the dreaded differential calculus.

But it illustrates yet another use for letters. The δ is not a quantity, like f or C, nor does it point out something on a diagram. It is more of an instruction to do something; in this example, to increase (or decrease, if there is a minus sign) f or C by a very small amount. It is, therefore, like other instructions, such as = or + or $\sqrt{}$.

Mathematical symbols are useful for saving time in writing things down, but that in itself is hardly mathematics. If one had to find the capacity of a cylindrical tank non-mathematically it would be necessary to fill it up with liquid laboriously measured out in a quart pot, or other standard container. And, having done so, one would be no further on towards measuring other cylindrical tanks; they would all have to be done in the same tedious way. But without moving from his desk the mathematician can say, "let l be the length of *any* cylindrical tank (in any agreed units, such as feet or centimetres), and d the diameter, in the same units. Then the volume, in cubic units of the same sort, of *any* cylindrical tank is $\frac{\pi d^2 l}{4}$, where π is what we said it was. Give him longer time, and he can work out the actual value of π to any required accuracy. All one has to do to find the capacity of a particular tank is to fill in the two easily measured dimensions and employ simple arithmetic.

The value of this is enormous. When a radio transmitter is ordered it is not necessary to keep on making transmitters until the right one is arrived at (if it ever is); the engineer sits down and works out the sizes of things from the requirements specified, and if the mathematician has been clever enough there should be at most only minor alterations needed when an actual transmitter has been built.

Now the majority of those who read this page do not have to do work like this; but even in everyday life it is helpful to tackle problems in a mathematical spirit instead of groping vaguely.

Of course, there are always some people who carry things too far, whether it be non-stop dancing or flag days or broadcast listening, and the mathematicians are no exception. One can start off with symbols representing definite things, and juggle with them so much that a stage is reached where the result conveys no useful meaning, if any meaning at all. This may be all right as a harmless and amusing pastime, but if one is attempting to investigate a problem, say, in radio, it seems to me that one should never lose touch with what the symbols mean. Otherwise it is quite possible for a discovery to be unearthed and yet not to be recognised and turned to good account. One reason why I am so slow in reading through a lot of mathematical working is that I am unhappy unless I can see at each stage what the symbols signify. It is not enough to agree that mathematically the working is correct. That is why, in my opinion, a writer should be obliged to state in words, every so often, what he has discovered. And then people may or may not be interested in the mathematical stages by which he has arrived at those conclusions. It depends on how much faith the reader has in him!

In any case, if the maths were deleted entirely it would probably not be clear what are the conditions under which his conclusions are true. Even the famous Ohm's law formula already looked at is not universally true. The conditions under which it applies are considered to be so well known that they are hardly ever mentioned; but in newer work it is very important to avoid applying results to conditions that lie outside the assumptions. It was just that sort of thing that made experts wrongly judge short waves to be no use for long distances.

Readers' Problems

A Selection of Queries dealt with by the Information Bureau, and chosen for their more general interest, is published on this page.

Screen Grid Voltage Supply

A READER has a receiver in which a tapped resistance is used as a potential divider to supply the screen grid in the RF valve, and this resistance has broken down. Owing to the age of the set and the absence of markings on the resistance it is impossible to determine its original value and we are asked to indicate a suitable value of resistance and tapping point for a replacement.

The set is AC operated and in view of its age most likely includes an HT supply unit giving about 200 volts at the working load. A potentiometer of 40,000 ohms total seems to us a reasonable value in this case, and if a centre-tapped resistance is used, or two 20,000 ohm resistances joined in series, the centre point will provide about the right voltage for the screen grid in the valve.

The potentiometer would pass 5 mA only, but as these early sets did not have variable-mu valves good regulation of the screen voltage is not essential.

Measuring Instruments

WE are asked to explain the difference between a voltmeter and a milliammeter as the "works" of the two instruments appear to be identical.

Actually there is no difference in the mechanism of the two instruments, for whether it is marked a voltmeter or a milliammeter the meter itself only responds to current.

The difference lies in the method of application. For instance, if voltage measurements are required a resistance is joined in series with the meter, its value being such that when the combination is connected

across a supply of say, 500 volts, sufficient current only is allowed to pass through the instrument to move its pointer over to the end of the scale. Though the instrument used may be 0 to 1 milliammeter, this point on the scale can be marked 500 volts. If the instrument is now connected across a 250-volt supply only 0.5 mA will flow corresponding to about half-scale deflections.

A full-scale deflection can be obtained for any desired voltage merely by joining a suitable value of resistance in series with the meter.

For the measurement of currents larger than that for which the meter is designed to pass resistances of suitable value are joined in parallel, or shunt, with the meter. Thus part only of the total circuit passes through the meter, the remainder flows through the shunt resistance.

It is this common ground of operation that enables a multi-range instrument to be produced that by the turn of a switch becomes either a voltmeter or a milliammeter (or an ammeter). All that the switching does is to connect appropriate resistances either in series or in shunt with the current measuring instrument.

For this explanation it is assumed that the voltages and currents are of the direct current kind, but it applies also to the universal type of meter that deals with AC as well as DC, as for the former a rectifier is used to convert it to DC before it reaches the meter.

There is a difference between the two kinds of instruments, but this is incidental, not fundamental, to their operation. A voltmeter invariably has a very high internal resistance, whilst a current measuring meter is of low resistance.

Stage-by-Stage Tests

HAVING constructed a three-valve battery set, a reader is dissatisfied with its performance. Sensitivity is poor and reaction is behaving in a very peculiar manner. It is reasonably satisfactory, though somewhat fierce in operation on the medium waveband, but on the long waves it has no apparent effect on signal strength, yet the detector valve can be made to oscillate.

This seems to be a case where haphazard testing is not likely to locate the trouble, and an orderly stage-by-stage test is indicated.

If a gramophone pick-up is available, the two audio stages, which, though not shown in the accompanying circuit, follow the detector, can quite easily be tested by connecting it in the grid circuit of the first AF amplifier. It can be judged from the results obtained whether or not this portion of the set is functioning correctly.

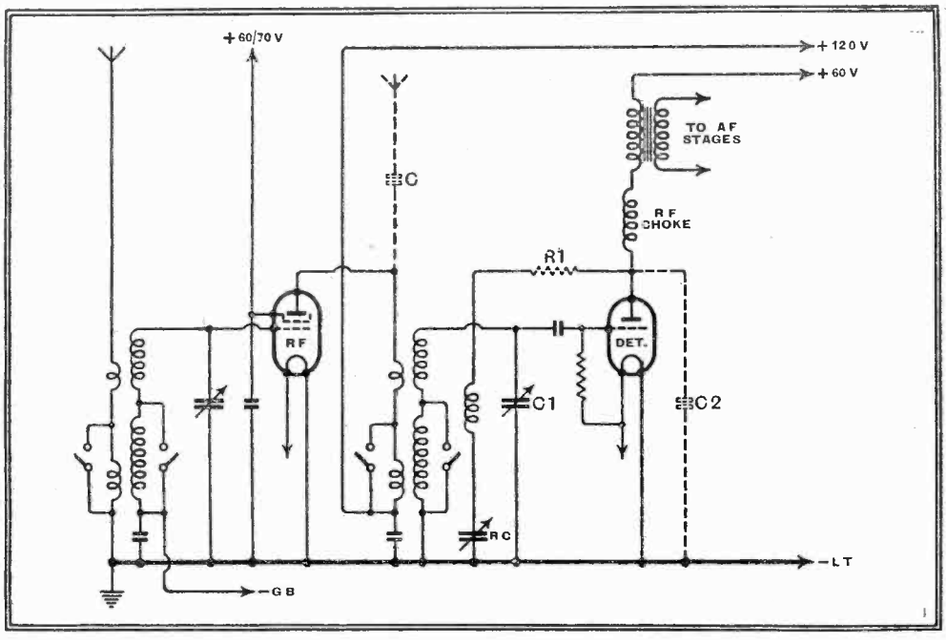
Assuming this aid is not available, then the alternative course is to join the aerial to the primary of the RF transformer and include a small condenser C of 0.0001 mfd or less as shown. The RF valve should be removed for this test; tuning is now carried out on C1, and although the selectivity will be poor, quite good signals ought to be obtained. If not, the detector and AF circuits should be examined for any error in the wiring or faulty component. During this test the opportunity might be taken to cure the reaction defects.

A condenser of about 0.0001 mfd joined in the position C2 will help to "tame" the reaction on the medium waveband, while if a resistance of about 500 ohms is inserted at R1 it should overcome the long-wave trouble.

What apparently is taking place is that the reaction circuit is oscillating at a different frequency to that to which the grid circuit is tuned. We would expect, however, its strange effects to be noticed also on the medium waveband. However, the same difficulty has in the past been encountered in sets having a single reaction coil, and it has always responded to this treatment.

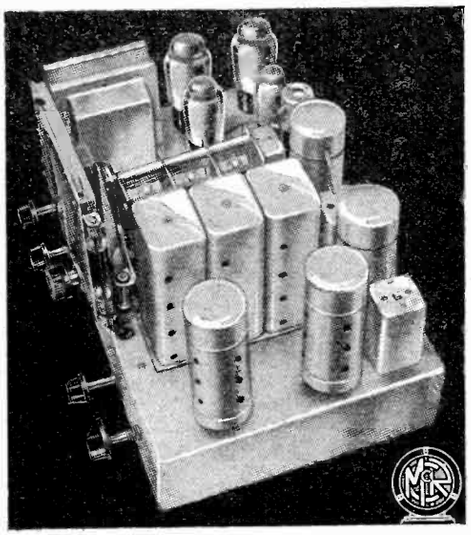
Actually, it would be better to move the condenser to the other side of the reaction winding, but it will have to be removed from the panel and operated by an insulated extension spindle.

Having corrected any faults in the detector-AF portion of the set, the RF valve can be replaced and the aerial returned to its proper terminal. If the RF stage is behaving correctly a very marked increase in signal strength should follow. If this is not the case, then there is either a wrong connection or a faulty component.



RF and detector circuits of the set for which a stage-by-stage test is described.

McCARTHY
The Chassis Specialists



IN modern radio practice, nothing is final; no receiver is so good that it is incapable of development in some detail.

Constant attention to improvement in small matters keeps McCarthy chassis in the forefront of modern chassis design and construction.

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The Circuit in Brief.—The pre-selector circuit is coupled to high-gain radio frequency amplifier operating on all 4 wave-bands, which is transformer-coupled to latest type triode-hexode frequency-changer. There are 2 band-pass transformer-coupled I.F. amplifiers (intermediate frequency 465 K.C.'s). The double diode second detector provides automatic volume control applied to 4 preceding valves, and first stage L.F. amplification. The triode phase-changer is capacity-coupled to push-pull output pentodes (or Harries-tetrodes) delivering 9 watts.

Principal Features.—Waveband coverage—12.8-33, 29-80, 190-550, 800-2,000 metres. Controls—sensitivity control (varying bias on R/F stage): 5-position wave-change and gramophone switch: combined volume control and on/off switch and progressive variable tone control (both operative on radio and gramophone).

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RANDOM RADIATIONS

By "DIALLIST"

Something for Nothing?

THERE still be those who fondly hope to get something for nothing, or next door to it, in the way of wireless gear, even though in their heart of hearts they know well enough that it can't be done. Here's a case in point. A man I know asked rather sheepishly when I was at his house the other day if I'd give him a hand at sorting out a kit of parts that he'd bought some time previously. Enquiries elicited that he had responded to an advertisement in a lay paper, which seemed to offer amazing value. It was very loosely worded, but it gave the impression that for a mere thirty shillings you could obtain the latest thing in American AC/DC "all-wave" receivers, complete with tubes. He parted with his thirty shillings and received in return for it not a made-up set, but a box containing an alleged kit of parts "with complete instructions for building the receiver." That the parts were mainly junk one could see at a glance—no makers' names on any of the condensers or resistances. The "complete instructions" consisted of a cyclostyled circuit diagram of the most elementary kind of straight 3-valve set.

So Clear!

This had apparently been drawn by the office boy from memory! Where he wasn't quite sure where one lead crossed another or was connected to it he had made a blur that might have represented either. Again, not one single value was shown. Nor, apart from this weird diagram, was there any kind of help for the would-be set builder. "Better write for full instructions," I suggested. "I've written three times already," said the victim ruefully, "and not one of my letters has been answered." I gave him the only advice that seemed to fit the case. "Throw the whole outfit into the dustbin," I said, "and forget about it. Even if you worried the thing out and built the set it would not be worth using." I don't think that he'll be caught again—though I wouldn't be too sure about it if his eye happens to light on an advertisement offering some astounding bargain for less than half what it would be worth, were it genuine. It takes all sorts to make a world.

Great Work

NO one who watched the England *versus* Scotland soccer match, as televised from Wembley, could begrudge the B.B.C. the self-administered pats on the back that formed part of the news bulletins that evening. It was a really first-rate show, and the B.B.C. was not far wrong in saying that it was the best piece of work that the O.B. staff of the Alexandra Palace has done yet. The light was exactly right for clear, contrasting images, and the emitrons rose nobly to the occasion. But it wasn't only the engineering people who excelled. Those in charge of the cameras manifested real showmanship by keeping the centre of play on the screen. I'm sure that no one who saw the match by means of a televisor missed very much of the game. Everyone I've met who "looked in" was loud in his praises. This transmission should go a long way towards giving television the boost that it needs, for many thousands of people must have seen it, not only in private houses, but in wireless shops and at centres such as the Ideal Home Exhibition.

A Look Ahead

IF you've ever been to the Grand National or the Boat Race you'll agree that you know much less about what's going on when you are actually on the spot than you do if you stay at home and hear the running commentary from your loudspeaker. At Aintree, even from the best place on the Grand Stand, you see only part of the race in any detail and know very little of what is going on when the horses are "out in the country"—especially if it's at all misty. At the Boat Race all that most of the throng see is the crews flashing past just one point in the four-mile course. The broadcast commentary enables you to follow either race clearly from start to finish. The *Magician* is just behind the crews the whole way in the Boat Race, and the "National" commentators are stationed at various vantage points. If sound broadcasting can do all this, how marvellous it will be when such events are televised in their entirety, as no doubt they will be before very long. The "in-looker" will indeed see most of the game!

Not So New

By the way, the B.B.C.'s plan for televising the Boat Race by showing model boats moved along a map of the course as telephoned or radio-ed information came through wasn't quite such a novel idea as many thought it would be. I wonder if any readers "saw" the Boat Race of 1906 (or was it 1907?) at the Union at Cambridge? If any did they may remember that a vast map of the course was hung on a wall of the room in which the debates are held. A trunk telephone line to London had been secured for the duration of the race, and over this observers stationed at many points 'phoned information about the positions of the crews. As each message came through cardboard boats, one light blue, one dark, were fixed in the proper places on the map by drawing pins. And so, fifteen years or more before broadcasting, let alone television, was in being, an audience of about a hundred people was able to follow the race through all its stages. It's true that nowadays the commentary or the images come through with no time-lag. But those who watched the Boat Race at the

Broadcast Programmes

FEATURES OF THE WEEK

THURSDAY, APRIL 21st.

Nat., 7.30, Joe Kaye and his Orchestra. 8, W. H. Berry in "Whose Hooper?" a musical play founded on Sir Arthur Pinero's farce. 9.25, "Handel in Rome," music played by a section of the Boyd Neel Orchestra.

Reg., 6, Charles Heslop Requests "The Pleasure of Your Company," variety from Eastbourne. 8.30, The Birmingham Philharmonic String Orchestra. 9.15, Cabaret from Bournemouth, including Jane Carr and Douglas Byng.

Abroad.

Brussels II, 8, "The Rhinegold," opera (Wagner).

Milan Group, 9.0, "Don Carlos," opera (Verdi), from Venice.

FRIDAY, APRIL 22nd.

Nat., 7.30, "Lines on the Map"—IV, Communications by Air. 8, As on Thursday at 6 p.m. (Reg.). 9.35, Robert Donat as the Man in "The Dark Lady of the Sonnets," by Bernard Shaw, the play preceded by a prologue written and spoken by the author.

Reg., 7.30, Dance Music from France. 8.30, European Concert from Norway. 9.30, Variety from Morecambe.

Abroad.

Berlin II, International Contemporary Music, including Bax's Sixth Symphony.

SATURDAY, APRIL 23rd.

Nat., 8, Music Hall, including Albert Sandler and Charles Hayes. 9.20, American Commentary. 9.35, Television at Work, a commentary by Thomas Woodrooffe on the attack on Zeebrugge, reconstructed at Alexandra Palace.

Reg., 6, W. H. Berry in "Whose Hooper?" 8, "My Eightieth Birthday," by Dame Ethel Smyth. 8.15, Sir Adrian Boult conducts B.B.C. Orchestra (B). 9, Victor Silvester and his Orchestra.

Abroad.

Radio Eireann, 7.15, "When Handel Came to Dublin"—a play.

SUNDAY, APRIL 24th.

Nat., 10.45 a.m., Fred Hartley and his Sextet. 11.30 a.m., Tollefsen, accordion. 6.30, Bavarian Songs from Munich. 9.5, World Theatre—VII, "Rosmersholm," by Ibsen.

Reg., 6, Bird Songs from the Forestry Commission Land near Bury St. Edmund's. 9.5, Songs from the opera "Fallen Fairies," music by Edward German, words by W. S. Gilbert. 9.50, Kneale Kelley conducts the Eastbourne Municipal Orchestra.

Abroad.

Stuttgart, 7.15, "Aida," opera (Verdi).

MONDAY, APRIL 25th.

Nat., 2, Speeches from the British Sportsmen's Club Lunch for Australian Cricketers. 7, "Monday at Seven." 8.20, Fraser Darling Talks on "Wild Life Around Us." 9.20, World Affairs. 9.35, Jack Hylton and his Band.

Reg., 8.15, Hoffmann Concert from the Queen's Hall, B.B.C. Orchestra conducted by Sir Adrian Boult. 9.25, From Manchester Centenary Dinner, speeches by Earl of Derby, Lord Hewart, Mr. Lloyd George and the Mayor of Manchester.

Abroad.

Berlin, 8, "Tannhäuser," opera (Wagner).

Brussels I and Radio Paris, 8.30, Franco-Belgian Exchange Concert.

TUESDAY, APRIL 26th.

Nat., 8, Scrapbook for 1928. 9.15, The Budget—Sir John Simon. 9.30, America Speaks. 9.50, Recital by Laffitte, pianoforte.

Reg., 6.30, Music from Czechoslovakia. 7.30, Peter Yorke and his Orchestra. 9, Old Time Music Hall.

Abroad.

Brussels II, 7, "Siegfried," opera (Wagner).

Stuttgart, 9, Handel Evening.

WEDNESDAY, APRIL 27th.

Nat., 5.20, Henry Hall and his Orchestra. 9.20, The Budget. Talk by Mr. Attlee. 9.30, The Melody is There.

Reg., 7.30, Band Waggon. 8.30, "Norway," tracing Norse influence on the North of England, with a special relay from Oslo.

Abroad.

Leipzig, 8.30, Bruckner's Eighth Symphony.

Warsaw, 9, Chopin Recital by J. Smidowicz.

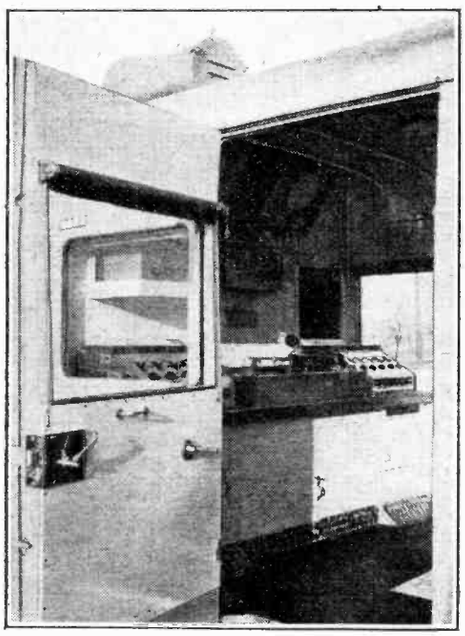
Cambridge Union all those years ago got their news only a matter of seconds late, which was pretty red hot for those days.

Atmospherics and the Short-waves

Some time ago I reported that the short-wave stations at Bombay and Delhi had had to raise their wavelengths to 90.77 and 60.06 metres respectively for their evening transmissions, which take place between 5.30 and 11 p.m., local time, or noon and 5.30 p.m. B.S.T. The change was made, if you remember, because the skip distance was found to be so enormous after dark when wavelengths in the 31-metre band were used. It will be interesting to see whether the longer wavelengths are successful during the hot weather, which is now under way. Atmospherics are poisonously bad during this season in most parts of India, and it remains to be seen whether they will not make it impossible to continue using a wavelength so long as 90 metres. Some valuable data concerning atmospherics have been obtained by Mr. S. P. Chakravarti, of the University of Calcutta. He has recently set up cathode-ray direction-finding equipment for the recording of atmospherics, and his present investigations into the wavelengths below 100 metres which are chiefly affected by them should form an important contribution to our knowledge.

Still Going Strong

A READER sends me an account of what must be one of the oldest receiving sets still in service. He saw it first in 1926 at the home of a friend to whom it belonged, though it wasn't by any means new then. His diary contains a note to the effect that in the hope of hearing the news on one of the early days of the General Strike he visited Mr. X and listened to it on his wireless set. "Couldn't make out what they were saying. It's only a one-valve set, however, with head-phones." Only a few weeks ago he again visited Mr. X and there was the same "one-lung" set with a cat's cradle of wires running to the accumulator and HTB on the floor and the same pair of head-phones resting on the arm of his chair. I have come across some pretty ancient sets still in use, but I think that this veteran, which is probably about fourteen years old, must hold the record for long and continuous service. Until recently I possessed a portable about eight years old which was employed for occasional jobs and was very useful at times in the sickroom. This set, though, had so frequently been brought up to date that very few of its original bits and pieces were still within it.



A PUBLIC ADDRESS van, used by the Stuttgart Municipality, carries two 150 watt amplifiers which provide enough power for twenty of the city's permanently installed loud speakers. The van's equipment also includes two microphones and suitable points for another six; two mixing desks, a double gramophone desk and a wireless receiver.

Portables of Yesteryear

Talking of portables, do you remember some of the early models? Some of them weighed 30 or 40 pounds and if you were rash enough to take one to a picnic you began to wonder after half a mile or so across country whether portable was really the correct epithet. One early portable of which I have recollections made things a bit easier since it was housed in two cases which could be carried separately. The most ancient portables of all did not contain built-in frame aerials. You carried with you a coil of flex, a ball of string and possibly a catapult. Your first business was to hurl or shoot a stone with a string tied to it over a convenient branch. You then tied on the wire and hauled up. In 1927 Pye was making a 5-valve portable with built-in frame guaranteed to receive Daventry anywhere in the British Isles—I wonder if they tried it in Cornwall?—for the modest sum of £30 12s. 6d. The Peto-Scott "Sociable Five" was cheaper at £29 10s., but then it did not claim to receive Daventry beyond 120 miles. By 1929 prices had come down. The "Symphony," whose reproduction was stated to approach very nearly to complete realism, cost a mere £17 6s., complete with Lido-Blue stormproof cover!

A Finicky Job

THE other day it fell to my lot to have to do one of those fiddling little jobs that sometimes come the way of those who make their own apparatus or keep it in repair. A "dis." was found to have taken place in a tiny coil wound with No. 42 silk-covered wire. Inspection showed a break in the wire, which was, luckily, at one of the ends of the windings rather more than a quarter of an inch from the tag which formed the fixed contact. There wasn't enough of the loose end to reach the tag, but it could just be made, without stretching it, to overlap for about a 32nd of an inch with a little piece of wire left attached to the tag. With a very fine bit it was just possible to solder the two together. I don't know whether you know the tip for making a soldering bit suitable for fine work of this kind. File off the point of an old soldering iron and drill in it a hole which is a push fit for No. 16 swg. copper wire. Cut off about an inch of this wire, insert one end into the hole and fix it firmly by hammering the bit. Shape off the protruding end of the wire neatly. You now have a soldering iron which will do finicky jobs well. Owing to its size, the original bit retains the heat, and the fine point, carefully tinned, which protrudes from it, makes miniature soldering jobs comparatively easy.

T.C.C.
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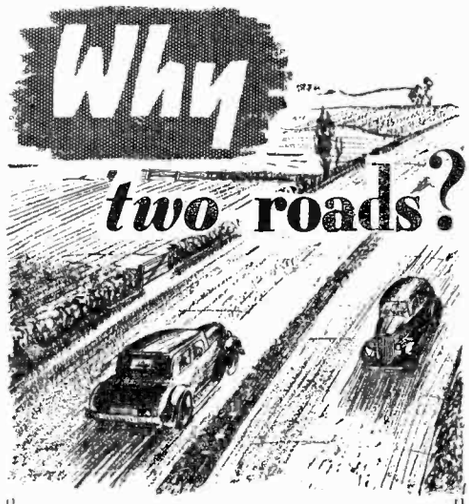

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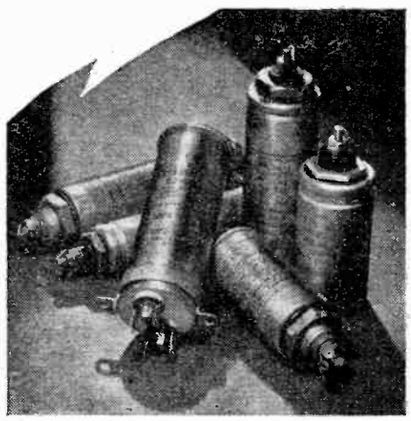

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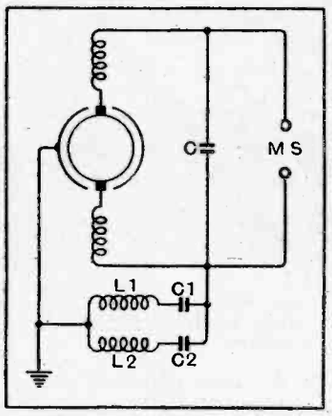
Recent Inventions

Brief descriptions of the more interesting radio devices and improvements issued as patents will be included in this section

"STATIC SUPPRESSORS"

"STATIC" disturbance from a dynamo or motor likely to interfere with broadcast reception is suppressed by the arrangement shown in the Figure. A condenser C is shunted across the mains supply leads MS, one terminal of the condenser being connected to the earthed framework through parallel condensers C1, C2 in series with inductances L1, L2. The series combination is designed to act as a band-pass filter for frequencies liable to create artificial interference and, in effect, by-passes them to the frame and so to earth. Since condensers arranged in this way can be made of lower value than those normally used for the same purpose, the risk of shock to the user of the machine or appliance is reduced.



Filter for suppressing interference from an electric motor.

The British Electrical and Allied Industries Research Association and L. H. Daniel. Application date July 18th, 1936. No. 478646.

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HIGH-FREQUENCY AMPLIFIERS

WHEN amplifying a wide band of signals, as for instance in television, a limit is set to the faithful reproduction of the higher frequencies by the inter-electrode capacities of the valves, even when screen-grid valves are used.

To overcome this difficulty, a screen-grid "buffer" valve is arranged between two successive amplifying stages. Although this does not add to the effective amplification, it serves to minimise the capacitative load of one amplifier on the other, and so prevents any falling-off in the proportion of high frequencies to low in the final output stage.

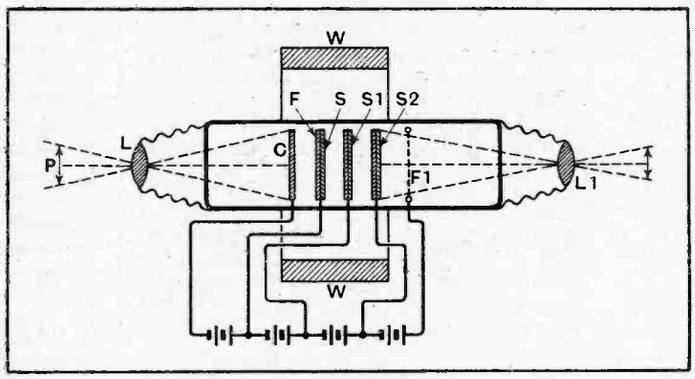
P. W. Willans; A. J. Brown; and Baird Television, Limited. Application date July 7th, 1936. No. 477815.

o o o o

"IMAGE INTENSIFIERS"

A PICTURE P is projected by a lens L on to a photo-sensitive cathode C, where the emitted electrons are focused by an external winding W on to a "composite" screen, which consists of a fluorescent material F backed by a photo-sensitive material S. The electrons from C produce a fluorescent light on the near side F of the composite screen, and this, in turn, gives rise to a further emission of electrons from the far or photo-sensitive side S of the screen. A similar action takes place at other intermediate screens such as S1, S2. The picture which is produced on the last fluorescent screen F1 is stated to be intensified in brightness and is finally projected by a lens L1 on to an external viewing screen.

V. Zeitline, A. Zeitline and V. Khlatchko (assignees of Cie pour la Fabrication des Compteurs, etc., à Gaz). Convention date (France) May 18th, 1935. No. 478641.



Details of photo-emissive electron multiplier.

TELEVISION RECEIVERS

THE fluorescent screen of a cathode-ray tube is not a plane surface, since it follows the curvature of the end of the glass bulb. Accordingly, when an optical system is used to project a magnified image of the picture on to an internal viewing-screen, it becomes necessary to correct for the initial curvature in order to prevent distortion.

According to the invention the cathode-ray tube is mounted in the receiving cabinet below the level of the viewing-screen so that it is out of sight of the observer, and an ordinary magnifying-lens is used to project the picture upwards. The viewing-screen, however, is made slightly convex in the direction of the observer, and this serves to offset the inherent distortion due to the curvature of the fluorescent screen.

E. Michaelis. Convention date (Germany) June 12th, 1936. No. 477814.

o o o o

DETECTING AEROPLANES BY RADIO

THE presence of an aeroplane hidden by fog or cloud is detected, and its position determined, by a method of direction-finding which depends upon the reflection from the invisible aeroplane of a beam of wireless waves used to "search" the sky.

As soon as the search beam sweeps across the hidden machine the downwardly reflected waves are picked up by a ground station and are fed to two cathode-ray tubes. These are so arranged that electrons are only liberated when the rotating frame aerial points towards the source of the reflected wave. Two luminous traces are thus formed, one on each of the fluorescent screens, and are then combined on an external screen in such a way that their point of intersection indicates the position of the hidden aeroplane.

E. Montu. Convention date (Italy) January 31st, 1936. No. 478456.

o o o o

PIEZO-ELECTRIC OSCILLATORS

A PIEZO-ELECTRIC crystal, suitable for high-frequency control purposes, is cut with its length parallel to the optical axis, its width parallel to the Y-axis, and its thickness parallel to the X-axis. The dimensions are so chosen that the crystal possesses only a single fundamental frequency along the X-axis and another along the Y-axis, one of these frequencies being a multiple of the other.

Such a crystal can be used to stabilize two different circuits at widely different frequencies, say, at 200 kc. and 2,000 kc., or at 100 kc. and 900 kc. respectively. It can, therefore, be used, for instance, to align and calibrate the tuning-dial scale of a wireless receiver.

Marconi's Wireless Telegraph Co., Ltd. (assignees of C. F. Baldwin and S. A. Bokovoy). Convention date (U.S.A.), June 29th, 1935. No. 476889.

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MAINS-SUPPLY UNITS

RELATES to means for obtaining sufficiently high voltages from direct-current mains to operate a television set. The known type of vibrating-contact rectifier is said to be inefficient and unstable. Objections are also taken to the use of a high-frequency oscillator for converting the DC into AC, chiefly on account of its disturbing effect on the receiving set and timing circuits.

According to the invention the problem is solved by using an oscillator valve which generates oscillations of the order of 2,000 cycles a second. These are stepped-up to the required voltage across a tuned transformer with a laminated iron core, and then rectified. The arrangement has the added advantage of enabling the voltage supplied to the set to be regulated simply by detuning the secondary of the step-up transformer.

E. Michaelis. Application date, July, 11th, 1936. No. 478300.

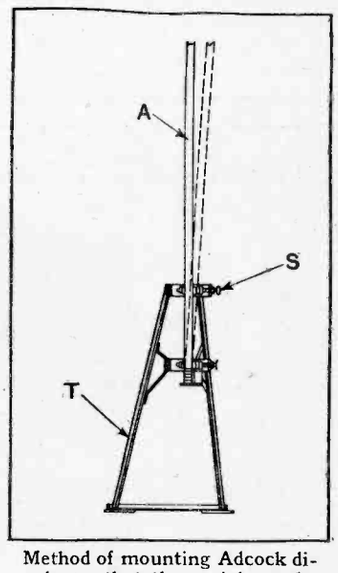
o o o o

DIRECTIONAL AERIALS

THE Adcock system of direction-finding depends upon the use of four vertical dipoles, which are erected at the corners of a square and are coupled in pairs through horizontal transmission lines to a central receiver. In the ordinary way the arrangement is free from the so-called "night error" caused by waves reflected down from the Heaviside layer.

It has been found, however, that a certain amount of field distortion occurs at each dipole when the surrounding earth is not homogeneous, owing to the creation of lines of force which are inclined at an angle to the earth instead of being perpendicular. This in turn tends to vitiate the accuracy of the bearings taken.

To overcome this difficulty each of the four dipole aerials, such as A, is mounted in a tripod stand T in such a way as to allow of its being set, by means of an adjusting screw S, at a slight angle to the vertical, as shown in dotted lines.



Method of mounting Adcock dipole so that the aerial can be tilted.

C. Lorenz Akt. Convention date (Germany), July 18th, 1936. No. 479330.

The British abstracts published here are prepared with the permission of the Controller of H.M. Stationery Office, from Specifications obtainable at the Patent Office, 25, Southampton Buildings, London, W.C.2 price 1- each. A selection of patents issued in U.S.A. is also included.

The Wireless World

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As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

CONTENTS

	Page
Editorial Comment	369
Balance and Control at Home.—I	370
The Home Laboratory.—II. Valve Voltmeter Construction ..	372
Electrostatic Deflection	375
Unbiased	377
Decca PT/AC Set Reviewed ..	378
". . . Not as Other Men" ..	380
Television Topics	381
News of the Week	382
Random Radiations	384
On the Short Waves	385
Valve Nomenclature	386
Recent Inventions	388

EDITORIAL COMMENT

Interference Suppression

Post Office Enthusiasm in Jeopardy

THE Postmaster-General, as the wireless licensing authority for this country, has shouldered responsibility for taking whatever steps are possible to reduce electrical interference which so seriously spoils the enjoyment of broadcast listening. It is some years now since this journal, recognising the menace of electrical interference to the future of broadcast reception and appreciating that as the use of electrical appliances increased so the matter was becoming more and more urgent, recommended that the only satisfactory way of tackling the problem would be by the introduction of legislation. Under the terms of such legislation the Postmaster-General would be given the necessary authority to oblige those responsible for causing unnecessary interference, whether users or manufacturers of electrical apparatus, to take reasonable preventive measures.

The First Steps

There seemed at the time to be so much uncertainty about how the matter should be tackled that we put forward the suggestion that the Institution of Electrical Engineers, as representing practically all the interests concerned, should appoint a Committee to go into the question in detail and pave the way for legislation. This suggestion was acted upon and the Institution formed a Committee of a widely representative character. This Committee deliberated for a long while, and ultimately reported in favour of legislation. We now await the presentation to Parliament of a Bill, having this object in view, which will be sponsored by the Postmaster-General.

There is so much delay in pushing on with this matter that it is perhaps not unnatural if, in the light of recent events, we should feel some misgivings as to whether Post Office enthusiasm over the matter of electrical interference suppression is as great as it formerly was. In a recent issue we remarked that the Post Office was becoming commercially minded to an extraordinary degree. Post Office trading profits, we said, break fresh records every year, and these achievements call forth unstinted admiration on all sides. We expressed the view that so long as the Post Office continued to confine its activities to the development of those sections of its services in which it has an exclusive field, it was unlikely that its successes would be hailed with anything but satisfaction.

Circumstances Have Changed

Recently, however, and long since committing itself to the task of eradicating electrical interference, the Post Office has shown determination to develop relay broadcast services throughout the country on a big scale. In conformity with the practice in their other enterprises these relay services would undoubtedly be conducted on a commercial basis with a view to profits on the undertaking. There is no disguising the fact that, in a very large measure, the success of a relay undertaking would be in proportion to the decline in the business done by independent wireless receiver manufacturers.

Now it is well known that relay services thrive in districts where electrical interference is severe, and that where reception by means of a broadcast receiver can be obtained without local disturbance there is little room for a relay service to succeed. How, we may ask, is the Post Office to be expected to exert every effort to suppress electrical interference for the benefit of users of broadcast receivers when such success must adversely affect the progress of their commercial enterprise in connection with relays? And the situation is not simplified when we remember that the same department of the Post Office deals with both these matters.

Balance and Contro

THE resonance and echo characteristics of the listening room may have a profound effect on quality of reproduction; means of making the best of local conditions are discussed in this article, while a succeeding instalment will discuss questions of audio-frequency output and speaker efficiency.

Part I.—INFLUENCE OF ROOM CONDITIONS ON RESPONSE

EVERYONE who has a wireless set wishes to obtain reproduction as nearly perfect as possible, yet it seems that real perfection will never be attained in the home, even if it were desirable, since it would demand the re-creation of all the conditions, visual, audible and mechanical, present at the original performance. For instance, perfect realism of an organ finale could not be attained without re-creating the characteristics of the hall. However, exceptionally fine quality can be achieved within a small room, if suitable steps are taken to use the set to the best advantage, this being possible owing to the ability of the ear to compensate for considerable discrepancies.

It is a common fallacy to suppose that "straight-line" response in set and amplifier would necessarily give perfect reproduction. As with all fallacies, there is a kernel of truth in this one; but the conditions obtaining in the listening room affect matters greatly, and balance is often improved by deliberate departure from linearity, in particular by tilting the response curve to correct for the deficiencies of the speaker and the "liveliness" of the room.

Since the action of the ear is as much physiological as mechanical, there can be no absolute standard of perfection, apart from the listener himself, and the ear must always be the final arbiter. If, for instance, the buyer can detect no difference in quality between two amplifiers of different performance, it is both logically and practically wrong for him to choose the dearer, simply because he is informed that it has a better response.

As an instance of how mere figures can mislead, take the case of two listeners in a concert hall, one near the front and the other at the back. These two receive the music at very different levels, and it might appear that they would hear diverse interpretations; actually, if they are used to concert-going their ears will make due allowance for the position, and they could discuss the interpretation the conductor had given without difficulty.

Passing to the detailed conditions of reception, we find that a scientific analysis of the acoustic constants of one room would cost more than the set, so that it is not possible to indicate positively the response required for each case, but the general principles can be given, and the reader will be able to select the treatment required in his particular instance.

The first point to consider is the position of the speaker; if this is in the set it must naturally be handy to aerial and earth connections, and convenient for tuning, which somewhat limits the choice, but a separate speaker is more flexible and may be mounted anywhere desired. Experience shows that, in general, an artificial effect is caused if the sound comes from above or behind the listener, for our ears are directional in their response, especially at the higher frequencies. If two speakers are used they should be as near together as possible, having regard to the minimum distance needed to prevent interaction, since a very distressing effect is produced on many people if two sound beams intersect near them. A separation of eight to twelve inches is enough.

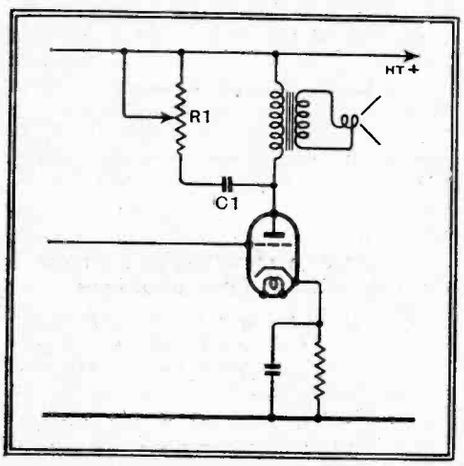


Fig. 1.—Method of introducing top cut by connecting a resistance-capacity filter across the primary of the output transformer. C1, 0.1 mfd.; R1, 0-25,000 ohms, variable.

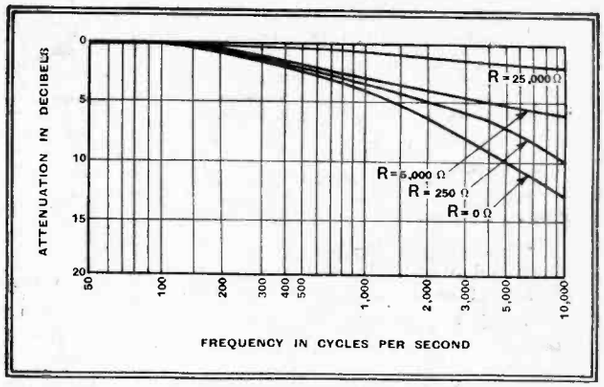


Fig. 2.—Amount of top cut introduced by a 0.01 mfd. condenser, in series with the various resistances shown, across an impedance of 3,000 ohms.

Mounting the Loud Speaker

The ideal position in most homes would be in the chimney-breast; this is difficult to arrange in the usual circumstances and a recess at the side will be a good substitute. Speakers directed downwards from the ceiling seem to be lacking in naturalness, however good their response.

Every enclosed space has to some extent the properties of resonance and echo, which will modify the normal quality of the set; usually the former will be more marked in small rooms and the latter in large ones. For many types of programme a certain amount of these two is very helpful, such items as the organ and large instrumental combinations being rather improved by it, but for speech it is undesirable in any large amount, reducing the intelligibility and lending an unnatural coloration to scenes supposed to take place in the open air. It is lucky that the average room, conventionally furnished with carpet, curtains and upholstered chairs, has a reverberation time well suited to the majority of items broadcast—perhaps it would be fairer to the B.B.C. to say "natural" rather than "lucky," since this is largely due to their efforts. The author well remembers the difference observed in a room where the floor, which had been hitherto covered with linoleum, was carpeted over more than half the area, for average items the conditions were greatly improved, but the amplifier characteristics had to be considerably altered before a large orchestra sounded natural, and even then the effect was not so realistic.

Microphone curves of response taken in a room should be accepted with some reserve since the setting up of standing waves may cause variations not matched by the ear, due to the fact that both ears are in use; also there are not many occasions when a note low in pitch is sustained for long periods.

Most readers will be familiar with the spurious resonances caused by such objects as vases, which are sharply tuned and re-radiate a certain note in their immediate neighbourhood. There is another manifestation of the same nature which may cause coloration of the programme if a high level is used; a piano can cause a large number of resonances when it is

ıt Home

By R. H. WALLACE

near a speaker giving a high acoustic output. Although the strings are damped, when not struck, by pads of felt they can still vibrate in such manner as would leave a node at the point of damping. This point varies, but in the case of the lower notes is such that harmonics of the order of the fifteenth can sound. These harmonics of the lower half of the keyboard all lie well within the audible range, although they are weak compared with the strength of the fundamentals. When a piano is in the room, and a large volume is used, it should therefore be as far from the hearer and loud speaker as possible.

Since the local factors are so variable it is impossible to design the set precisely to suit them, and it is essential, for the best results, to adjust the response in the room in which it will be used. Here is the designer's justification for a normally level output, since a set with such characteristics will not sound really bad, and gives us a good starting point from which to begin our modifications. In the final stages of this job the help of a friend with a good musical ear is invaluable, since one is apt to imagine the result one knows should follow a given alteration, while an independent observer is not so handicapped.

Methods of Compensation

In the absence of real tone controls in the set the following are some of the methods useful in specific cases, or a tone control unit, such as was described in *The Wireless World,* can be constructed and the best combination found by trial. Suppose the room is too "dead" and reproduction lacks brilliance, then we can increase the proportion of top by means of a tweeter speaker, fed through a condenser of 0.25 to 0.01 mfd. capacity; the value will give a measure of the amount of top introduced. The condenser should be connected across the primary of the output transformer. The same effect can be achieved, if the existing speaker has a good top response, by reducing the value of a coupling condenser in the amplifier section so that the lower notes will be cut in proportion to the higher ones.

On the other hand, if there is too much top in the reproduction the balance can be corrected by a resistance-capacity filter across the primary of the speaker transformer, or, more elegantly, by boosting the lower frequencies in the amplifier itself.

There are strong reasons for suggesting that the tone controls, if fitted, should be regarded rather as preset than panel controls, and if the set is suitably balanced they should rarely need altering for radio reception; a better control for varying conditions being afforded by manuipulation of a variable-selectivity device in the RF circuits.

The alterations suggested in this article cannot be made without some trouble but are well worth while, and will provide a good insight into the effects caused by small experimental alterations in the coupling constants of the amplifier.

In a concluding instalment the author will discuss the amount of AF output required for good reproduction under various conditions.

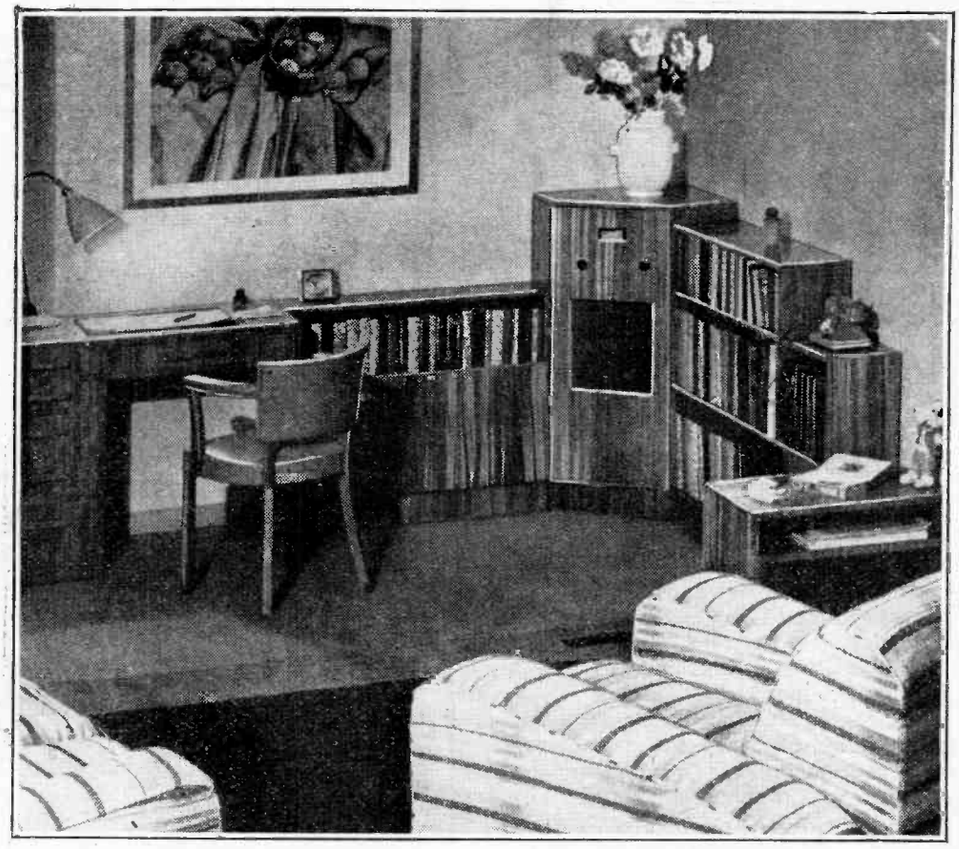


Photo by courtesy Bowmans

The modern "made to measure" furniture lends itself well to the incorporation of a radio set and in some cases adds considerably to the effectiveness of the baffle.

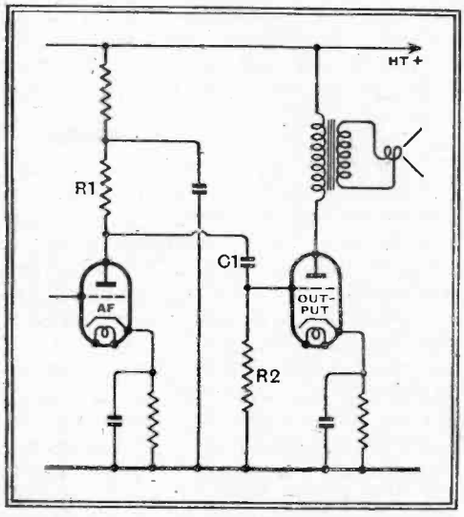


Fig. 3.—A resistance-capacity AF stage; reduction of C1 from the normal value will give a controllable bass cut. R1, 30,000 ohms; R2, 1 megohm; C1, 0.01-0.2 mfd.

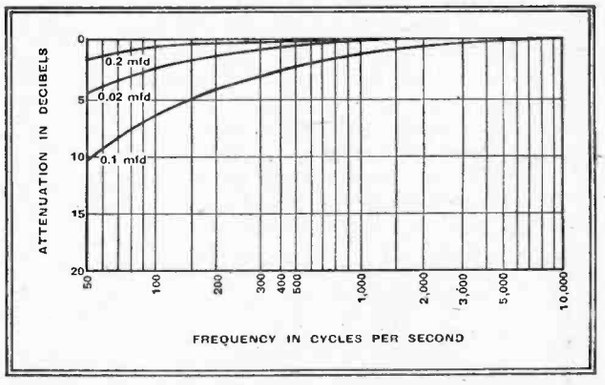


Fig. 4.—Amount of bass cut introduced by the circuit of Fig. 3, when the values of coupling capacity shown are used.

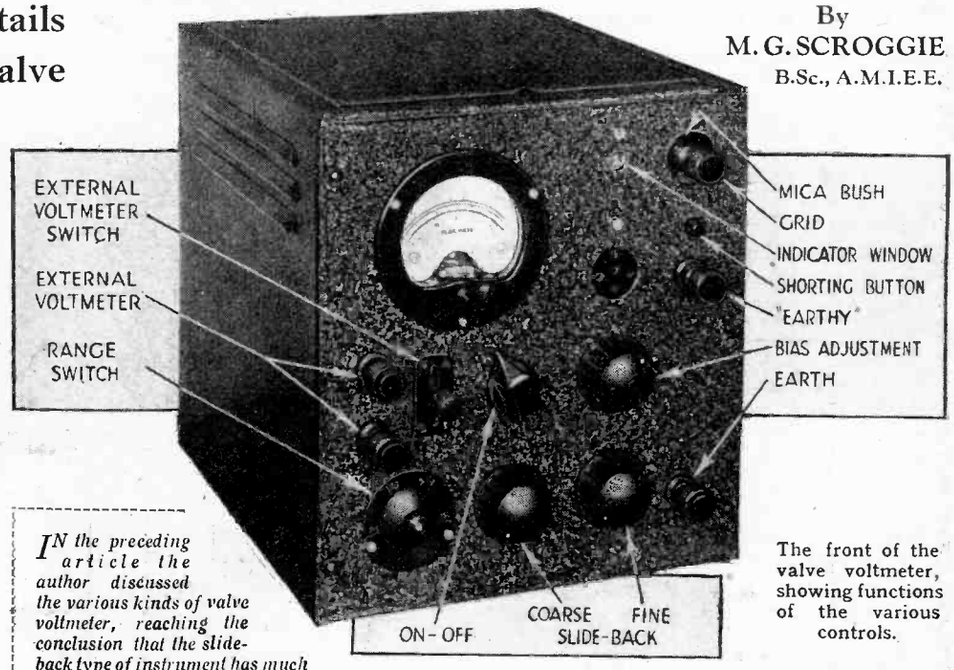
ALL-WAVE MODULATED TEST OSCILLATOR

In next week's issue full constructional details will be given of a modulated test oscillator covering some 100 kc/s to 30 Mc/s (3,000-10 metres) in six bands. Dry battery operation is adopted, and the two valves are used in such a way that the output control has no effect on the oscillator frequency.

The Home Laboratory

Part II—Constructional Details of a Novel Slide-back Valve Voltmeter

By M. G. SCROGGIE B.Sc., A.M.I.E.E.



The front of the valve voltmeter, showing functions of the various controls.

IN the preceding article the author discussed the various kinds of valve voltmeter, reaching the conclusion that the slide-back type of instrument has much in its favour, and that most of its weaknesses can be overcome by suitable design. The construction of a slide-back meter which employs an inexpensive cathode-ray indicator is fully described in this instalment.

ALTHOUGH the circuit diagram (see Fig. 1) of the slide-back voltmeter to be described may look alarmingly complicated, that is only because a highly developed form is shown, including such things as provision for the use of either of the two types of valve recommended. If preferred, a much simpler version can be made by omitting such optional features as the duplicate valves and the DC voltmeter with its range switching.

The outstanding advantages of this instrument are:—

(1) The calibration is practically unaffected by supply voltages and valve characteristics.

(2) Nearly infinite input impedance.

(3) Measures from 0.1 to 250 volts peak.

(4) Can be extended upwards to read any voltage in reason.

(5) No microammeter needed, and even DC voltmeter optional.

(6) Meter, if incorporated, cannot be overrun.

(7) Measures at any frequency up to 100 Mc/s or more and down to zero (DC).

For use at very high frequencies, especially those over 30 Mc/s, and across very low-loss circuits, the "acorn" valve offers substantially higher input impedance than those of conventional construction, partly because of its low grid-to-other-electrodes capacity (2-4 mmfd., compared with 7-16 mmfd.), and partly because of its reduced electron transit-time effect (typical input resistance at 60 Mc/s is 45,000 ohms, compared with 5,000 ohms). On the other hand, it is a more expensive and delicate valve, and it should not be used for measuring voltages over about 100.

With the instrument illustrated one is able to enjoy the best of both worlds; where minimisation of losses is important the acorn is used at the end of a cable plugged into the panel, so that it can be brought right to the work instead of having to be connected by high-frequency leads. The input resistance of the instrument, measured at 1 Mc/s, is nearly 10 megohms, and the capacity is 4 mmfd. Connection is direct to the grid, of course, for it is used chiefly across closed tuned circuits. For low frequencies or high voltages, or where an indirect connection is necessitated by a superimposed voltage or the absence of a closed circuit, and generally where the use of leads and a somewhat lower impedance are not objectionable, the internal HL4g is more convenient. Its input resistance, including the associated circuit, also at 1 Mc/s, is 1.9 megohms and capacity 11 mmfd.

By using a flexible "probe" the grid of the voltmeter valve may be placed "on the job," thus avoiding long live leads.

Incidentally, the above figures are for the valve hot; if it is switched off they alter very slightly towards a lower impedance.

If for economy the acorn is omitted, provision should be made for improving the HL4g for high-frequency use by cutting out the indirect connection, and perhaps by using the "probe" mounting shown here for the acorn. If both valves are fitted, whichever is not in use ought to be withdrawn.

The DC Voltmeter

The slide-back voltage controls are calculated for use in conjunction with a voltmeter taking 5 mA at full deflection; and alternative schemes are to use an external DC voltmeter, with a calibration curve for the lower voltages, or to omit the voltmeter entirely and use a simpler form of potential-divider calibrated in volts. This device then really earns its common title of *"potentiometer."* The last method is not highly accurate, of course, but for many purposes it is not really essential to have a calibration at all.

The Reliance Manufacturing Company can supply a set of potentiometers; a single one of 500 ohms for initially adjusting the bias to "zero," a double gang of 200 ohms each for covering the lowest range and for fine adjustment on the other ranges, and a triple gang of 2,000, 10,000 and 50,000 ohms for these three ranges. A Ferranti instrument switch controls the range of the meter and simultaneously connects the appropriate potentiometer. The last switch position is vacant and permits an external source of volts and/or voltmeter to be connected. The photograph shows a switch for changing from internal to external voltmeter or both in

The Home Laboratory—

parallel, but it has been omitted from the diagrams as being superfluous.

Another object of the "External Voltmeter" terminals is to render the 0-250-volt supply available externally for other uses.

The general working of the apparatus and use of the "magic eye" as a sensitive indicator for setting the anode current of the valve to a fraction of a microamp. was described in the previous article.

The TV4 differs from most other cathode-ray indicators by displaying a pattern resembling a Maltese cross, the effect of greater negative bias being to widen the illuminated sectors and narrow the arms of the cross. For instrumental purposes this form of indication is not quite so suitable as the single sector of other makes of tube, but, unfortunately, they have a much larger grid bias and correspondingly lower sensitivity. It is best to concentrate on one of the four arms of the cross, viewing it through a small window as shown by the dotted circle in Fig. 2.

If the grid of the TV4 is short-circuited to cathode the illuminated sectors narrow almost to lines. A certain amount of grid current flows which, with the 1 megohm in circuit, biases the grid slightly, the illuminated area when there is no other bias than this being somewhat as shown in Fig. 2. Although this corresponds to zero anode current in the valve, for reasons already given it is not advisable to try to adjust to this condition, but rather to some such current as a third of a microamp. This can be judged by reducing the valve bias slowly until the start of current is clearly seen by an appreciable increase in illuminated areas, the boundaries of which can be marked on the glass at the end of the tube in Indian ink or other convenient manner.

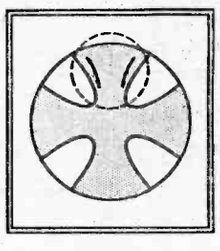


Fig. 2.—Type of visual indication given by the TV4 tube. The slide-back is adjusted until the boundaries of the pattern coincide with the marks. The dotted circle indicates the position of the viewing window in the panel.

By-pass condensers are used to form short high-frequency paths around the valve; comparatively large capacities are fitted in the body of the instrument in order to cope with low frequencies, but to by-pass the flexible cable for very high frequencies condensers of 0.0005 or 0.001 mfd. are connected in the "probe" in such a way as to give the most direct paths.

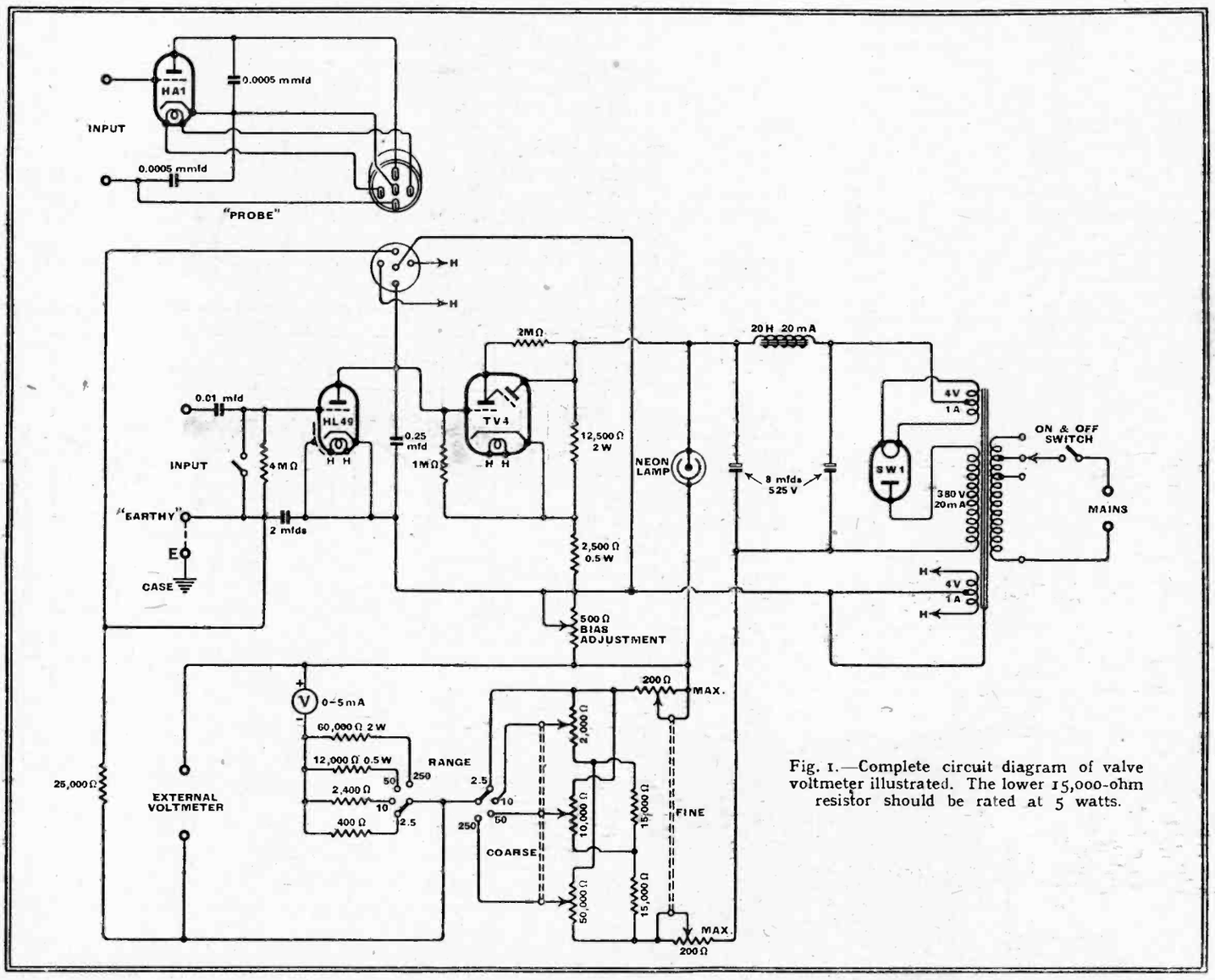


Fig. 1.—Complete circuit diagram of valve voltmeter illustrated. The lower 15,000-ohm resistor should be rated at 5 watts.

The larger condensers serve additional purposes; the one from "earthy" terminal to cathode (across the slide-back), in co-operation with the 25,000-ohm resistance, removes any ripple left over from the smoothing filter. The anode-cathode condenser prevents any AC component from blurring the outline on the TV4 screen. An excessive capacity here makes the indicator sluggish. It is vital for the condensers to be free from appreciable leakage, and the valves should be free from "backlash" (i.e., negative grid current). If one cares to take the trouble to test for such leakage currents it can be done with a TV4 in much the same way as the small anode current is detected.

The supply voltages to valve and indicator are stabilised by the "beehive" neon lamp, which must be ordered *without* internal resistance and connected so that the wire spiral is illuminated. If

The Home Laboratory—

the disc glows the lamp should be reversed.

As the peak voltage across the first power filter condenser normally exceeds 500 volts slightly it should be rated to work at 525 or preferably higher.

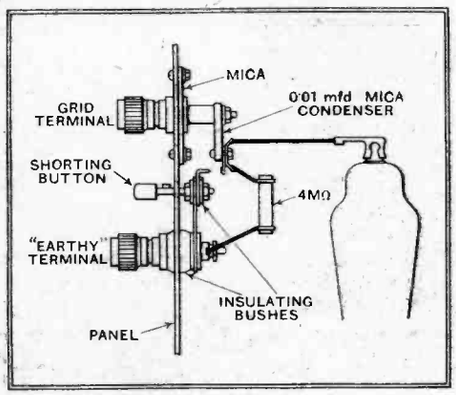


Fig. 3.—Showing how the short-circuiting switch is arranged to minimise input capacity and losses.

Sometimes one wants to apply a valve voltmeter to points that are live to earth (e.g., across a coupling in an anode circuit) and the "works" are therefore insulated from the metal case, but can optionally be earthed to case by joining the "earth" and "earthy" terminals. If it is considered worth while using a 6-pin socket, the cable screen and metal casing of the "probe" can be treated likewise; with a 5-pin socket the next best thing is to common it with the "earthy" lead. The transformer screen and valve metalising are joined to cathode.

The probe is built up of part of a suspension lamp fitting, the flange of a batten holder, a shade ring, and a strip of copper sheet soldered around to form the cylindrical portion.

It is useful to be able to short-circuit the input to the valve, especially with the indirect connection, for it can then be done without risk of shorting any DC supply included in the circuit being tested, and a button is provided on the panel for this purpose. Possibly there are suitable low-loss switches, but the one shown was extemporised and arranged, after considerable thought, in such a way as to introduce a minimum of extra capacity and loss. When pushed in it stays in and keeps the input shorted till it is released by depressing slightly (Fig. 3). The grid terminal is mounted on a piece of selected mica.

The voltmeter is scaled to read peak volts directly, the maxima for the ranges being 2.5, 10, 50 and 250 volts. It could, of course, be scaled to read RMS volts by dividing the readings by 1.404, but they would be liable to error when measuring distorted wave-forms.

The initial adjustment before using the apparatus is to have the slide-back controls at zero and set the bias control until the indicator registers with the "zero" marks. This adjustment usually needs to be done only at the start, preferably after about five minutes' warming-up, but differs according to which valve is in use. When a voltage to be measured is applied the illumination advances, and is brought back by adjustment of the slide-back controls.

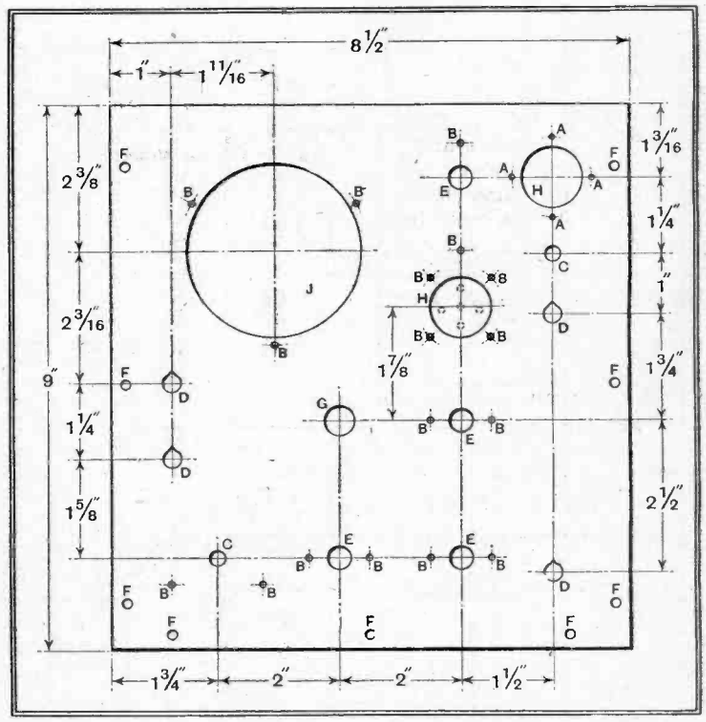
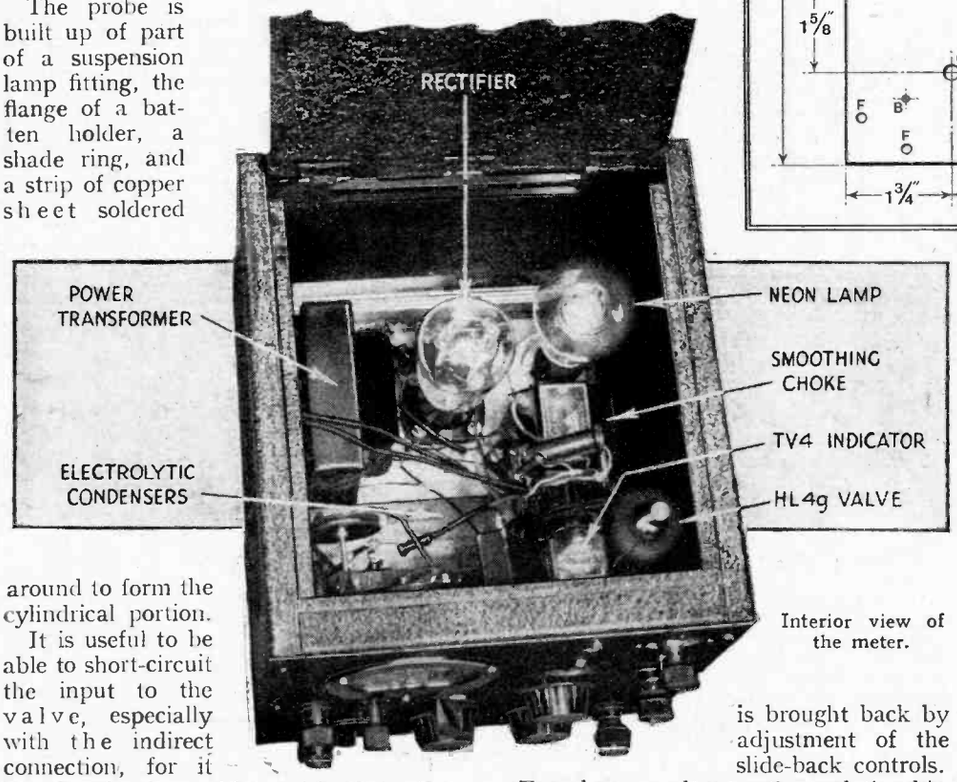


Fig. 4.—Panel drilling diagram. Sizes: A, 3/32 in.; B, 1/8 in.; C, 1/4 in.; D, 5/16 in., for Belling-Lee terminals; E, 3/8 in.; F, fixing holes; G, 1/2 in.; H, 1 in.; J, 2 7/8 in.

For large voltages the relationship between signal peak voltage V_p and slide-back voltage V_s is given approximately by $V_p = a V_s - b$.

Assuming a "zero" current of about half a microamp, a is not greater than 1 by more than about 1 per cent.; b depends on the valve, but is normally about 0.5 to 0.7. So for voltages above the region of 20 there is not more than about 1 per cent. error in taking $V_p = V_s$, and only a DC voltmeter is needed for calibration, which may quite well be more accurate than a calibration on AC. In fact, from 2 volts upwards the accuracy is still quite useful. The lowest range, however, definitely requires AC calibration, which can be done by dividing off the 50 c/s supply by means of known resistances, or in any other way that may be available. The scale shown was calibrated with a HL4g valve, and was found to hold good for such a different valve as the Osram HA1 acorn by adding 0.1 volt to all readings. A signal of 0.1 volt produces a deflection on the lowest range, but the scale is very cramped as far as 0.5 volt.



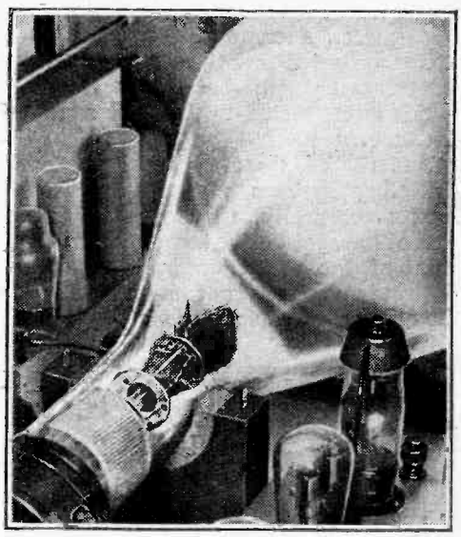
Interior view of the meter.

Although there is a good deal of latitude in the choice of some of the components used, the following list of the more important items may be helpful:—

Bias control	**Reliance type TW**, 500 ohms
Fine slide-back control (double-gang)	**Reliance type TW** {200 ohms, 200 ohms}
Coarse slide-back control (triple-gang)	**Reliance type TW** {50,000 ohms, 10,000 ohms, 2,000 ohms}
Meter	**Ferranti 0-5 mA**
Range switch	**Ferranti Type 6**
Case	**Eddystone 1033**
Power transformer	**N. Partridge Special** 4 volt 1 A, 4 volt 1 A, 380 volt 20 mA
Smoothing condensers	**Dubilier 0288**
5-way cable plug	**Bulgin P36**
Resistance, 15,000 ohms	**Bulgin PR12**
Detector valves	**Tungsram HL4g, Osram HA1**
Rectifier valve	**Dario SW1**
Tuning indicator	**Mullard TV4**
Neon lamp	**Osglim 59**

Electrostatic Deflection

WITH PARTICULAR REFERENCE TO HIGH-VACUUM TUBES



By O. S. PUCKLE, A.M.I.E.E.

AN explanation of the causes of image area, distortion and astigmatism in cathode-ray tubes, with suggestions for overcoming these defects.

AT first sight the problems connected with the electrostatic deflection of a beam of cathode rays would appear to be capable of solution by means of very simple circuits. That these problems are, in fact, not easily solved has become increasingly apparent as the cathode-ray tube has been developed.

As is often the case, the elimination of one fault in the cathode-ray tube has brought to light others which were previously masked by still greater faults. The change from gas-focused to high-vacuum tubes and the gradual development of the latter has made it obvious that the application of an asymmetric deflection potential, whether AC, DC or a mixture of both, is unsatisfactory in the majority of cases, e.g., where the amplitude of deflection is more than about 10 per cent. of the screen diameter.

The circuit arrangement adopted for asymmetric application of the deflecting potentials is shown in Fig. 1. When two deflecting systems are arranged so that they lie mutually at right angles to one another,

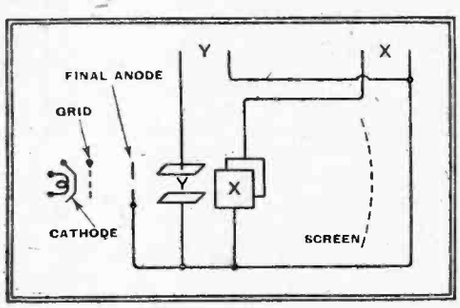


Fig. 1. Asymmetrical connection of two pairs of deflector plates.

and in such a manner that one pair of deflectors is nearer to the fluorescent screen than the other, a change of *mean* potential of the pair nearer to the screen modulates the sensitivity of the other pair. The arrangement behaves as though the velocity of the electrons in the beam between the plates nearer to the anode was modulated by the variation of mean potential of the other pair. A change of mean potential necessarily occurs in an asymmetric system since one plate of a pair is constantly varying in potential, the voltage on the other plate remaining fixed. The deflectional sensitivity of a pair of deflectors in a cathode-ray tube is equal to $\frac{K}{V}$ where K is a constant depending on the geometry of the tube, and V is the potential through which the electrons have fallen. Thus, in order to determine the sensitivity of the pair of plates further from the screen, a factor dependent upon the instantaneous effective potential on the live deflector nearest to the screen must be added to the voltage of the final anode in order to obtain the correct value for V.

The foregoing remarks will be more easily appreciated if it is borne in mind that the electrons forming the beam are controlled by the electric fields through which they pass, and these fields control the *velocity* of the beam in the plane of the field concerned. Hence, the beam of electrons attains various velocities in different parts of the tube. Electron velocity is usually expressed in "equivalent volts," the appropriate voltage at any point in the path of the beam being that through which the electron has fallen on its passage from the cathode. Thus, if there is a difference of potential of 5,000 volts between the final anode and the cathode, the electron velocity at the anode is expressed as being 5,000 volts. The electrostatic deflectional sensitivity is inversely proportional to the square of the electron velocity at the point at which the deflecting field is applied, it being, of course, understood that the deflecting field appears at right angles to the direction of motion of the beam.

Influence of Various Fields

The velocity of the beam at any one point along its length is actually a compound one, due to the original radial velocity acquired by the electrons when emitted from the cathode, the sum of the longitudinal velocities due to the various accelerating fields existing between the focusing electrodes and the transverse fields produced by the potentials applied to the deflectors.

There are also several minor fields which still further complicate the force acting on the beam; the more or less longitudinal decelerating field due to the charge acquired by the fluorescent screen by electron bombardment, the fields produced by charges on the surface of the glass together with that due to the presence of secondary electrons emitted from the screen, and, finally, the radial field due to mutual repulsion of the electrons forming the beam.

When two pairs of deflectors are connected asymmetrically, as shown in Fig. 1, and fed with two DC potentials which may be separately varied, the resultant area of the image will be like a quarter of a trapezium. Fig. 2 will make this clear. Assume that the potentials on the two deflectors X and Y may be varied from 0 to 100 volts positive with respect to the potential of the anode to which the other two deflectors are connected. Let (b) denote the position of the spot when deflector Y is at a potential of 100 volts and X at zero potential. If Y remains at 100 volts positive and the same potential is applied to X the spot will move to position (c). Note that the distance (cd) is less than the distance (ab), because the sensitivity of the Y deflector has been reduced due to the potential on X. If, now, the potential on Y be reduced to zero, leaving that on X at 100 volts positive, the spot will move to position (d). Upon removing the voltage from the X deflector the spot returns to position (a).

If the circuit is arranged so that the

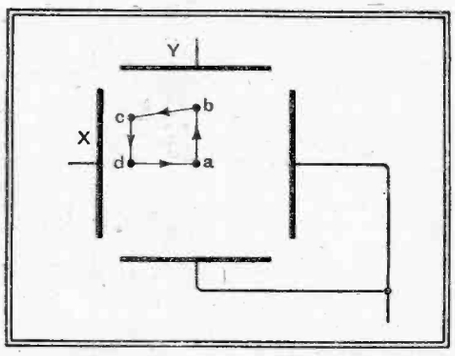


Fig. 2. Deflection of the beam by the arrangement of Fig. 1.

Electrostatic Deflection—

plates are fed with AC potentials (the potential on Y being at a higher frequency than that on X), thus causing the X and Y deflectors each to become alternately positive and negative to a peak potenial of, say, 100 volts, then the area covered by the image is as shown in Fig. 3, i.e., a complete trapezium. It should be noted that the long edge of the trapezium lies adjacent to that X plate which is connected to the final anode of the tube.

The use of these simple asymmetric deflecting systems also introduces, at least theoretically, two forms of distortion of the spot on the screen; an enlargement of the spot and astigmatism, or drawing out of the spot into a line in the direction of the deflection.

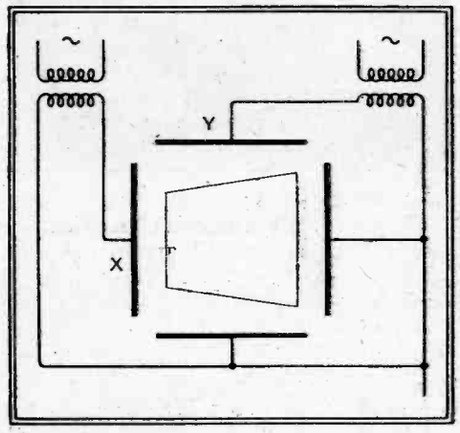


Fig. 3.—Shape of the area covered by the image with alternating deflecting potentials.

It should be clear from the foregoing remarks that trapezium distortion is due to the fact that the mean potential between the deflectors is not constant with respect to the final anode of the electron lens system.

The mean potential can obviously be kept constant by applying the deflection in a symmetrical manner to both plates of each pair, but the word "symmetrical" requires to be accepted in its literal sense. This means that the two potentials must be equal at every instant or, alternatively, that their algebraic sum must be constant.

Unfortunately, however, the above considerations, while sufficient to avoid trapezium distortion, are not enough to ensure the best results, as astigmatism must also be avoided. It is, therefore, further necessary to arrange that the mean potentials between each pair of deflectors and the anode are not only constant, but that they remain fixed at specific values.

Astigmatism has the same meaning in electron-optics as in light-optics, i.e., it denotes the condition existing when one obtains good focus in one direction and lack of focus in a direction at right angles to the first. Astigmatism may be introduced by certain transverse fields, and especially by any misalignment of the electrodes forming the electron lens system. Furthermore, asymmetry of position of the deflectors with respect to the hole in the final anode is a serious cause of defocusing of the spot.

The amount of error in electrode alignment which can produce astigmatism in a cathode-ray spot is so small that the majority of tubes supplied by any factory show some signs of this defect. For this reason it is advantageous to be able to correct astigmatism in the circuits external to the tube. To this effect, it is only necessary to arrange that the mean potential between each pair of deflector plates and the final anode may be separately adjusted. By this means, we introduce two variable cylindrical lenses at right angles to one another which can be adjusted so as to neutralise the effective cylindrical lens action introduced by small displacements of the electrode system from true alignment.

The necessity for adjustment of the mean potential of each pair of deflectors to a fixed value with respect to that of the final anode is unfortunate since it adds to the complexity of the associated circuit, but, where large deflections are required, the resulting improvement in focus is generally appreciable. The potential required for this purpose varies with different tubes even though they are made to the same design. Fig. 4 shows one method of arranging the circuit to provide means of adjustment.

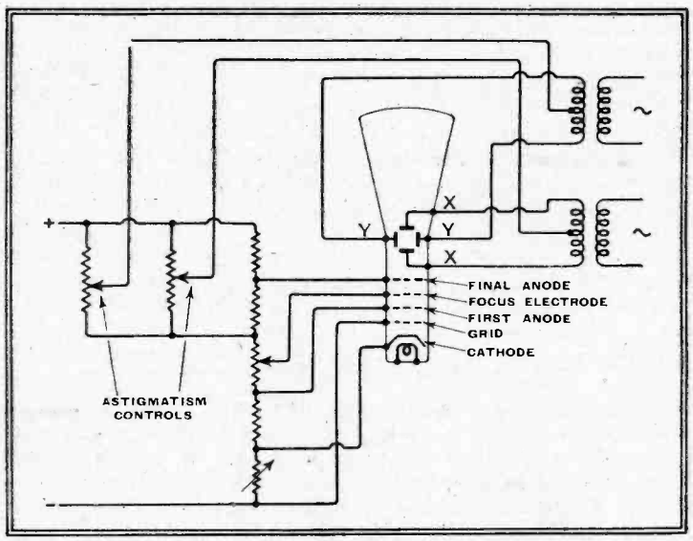


Fig. 4.—Method of correcting for astigmatism.

In conclusion, the following details must receive meticulous attention if the cathode-ray tube is to provide good focus all over the screen and if trapezium distortion is to be avoided.

Details connected with the manufacture of the tube:—

(a) The beam must be circular in cross-section.
(b) All the electrons in the beam must pass a given point with the same longitudinal velocity.
(c) All the fields through which the beam passes must be homogenous.
(d) The electrode structure should be in perfect alignment.
(e) The electrode apertures must be perfectly circular.

Details connected with the use of the tube:—

(f) Except for very small deflections the two deflecting potentials must be symmetrically applied, and, finally,
(g) The mean potentials of the two pairs of deflectors should be constant and should bear definite but unspecified relationships to the potential of the final anode.

Television Programmes

Vision	Sound
45 Mc/s.	41.5 Mc/s.

THURSDAY, APRIL 28th.

3, Intimate Cabaret. **3.25,** British Movietonews. **3.35,** 141st edition of Picture Page.

9, "Marshal your Facts," with Arthur Marshall, Wendy Toye and Charles Heslop. **9.30,** Gaumont-British News. **9.40,** 142nd edition of Picture Page. **10.15,** News Bulletin.

FRIDAY, APRIL 29th.

3, "Ah! Wilderness," a comedy by Eugene O'Neill; cast includes Percy Parson, Kitty De Legh and Joan Miller. **3.50,** Gaumont-British News.

9, Herbert Sutcliffe, the cricketer, shows "How It's Done." **9.5,** Intimate Cabaret. **9.20,** British Movietonews. **9.30,** Russell Thorndyke in his play "The Tragedy of Mr. Punch." **10,** News Bulletin.

SATURDAY, APRIL 30th.

2.27, O.B. from Wembley Stadium of the F.A. Cup Final between Preston North End and Huddersfield Town. **4.40-4.55,** "The Three Bears," a short ballet to music by Eric Coates and choreography by Joy Newton.

9, Intimate Cabaret. **9.30,** Gaumont-British News. **9.40,** Commentary on Darts Match between a B.B.C. Four and a Team from the Press Club. **9.55,** Cartoon Film. **10,** Repetition of 4.40 p.m. programme. **10.15,** News Bulletin.

SUNDAY, MAY 1st.

8.50, News Bulletin. **9.5,** David Seth-Smith presents "Friends from the Zoo." **9.20-10.30,** "Tobias and the Angel," a play by James Bridie; cast includes Tyrone Guthrie, Jean Cadell and Frank Bennett as Tobias.

MONDAY, MAY 2nd.

3, "There's always Juliet," a comedy by John Van Druten; cast includes Leonora Perrycoste, Leonard Corbett and Michael Shepley. **3.50,** British Movietonews.

9, Starlight. **9.10,** Talk on Fashions. **9.35,** Gaumont-British News. **9.45,** Harriet Cohen with the Television Orchestra. **10.10,** News Bulletin.

TUESDAY, MAY 3rd.

3-4, "Acis and Galatea," a pastoral with music by G. F. Handel performed as a masque; cast includes Parry Jones and Isobel Baillie.

9, Starlight. **9.10,** "In your Garden"—C. H. Middleton. **9.20,** British Movietonews. **9.30,** Repetition of Friday's 3 p.m. programme. **10.30,** News Bulletin.

WEDNESDAY, MAY 4th.

3, Forecast of Fashion. **3.15,** British Movietonews. **3.25,** Jack Jackson and his Band **3.55,** Cartoon Film.

9, Repetition of 3 p.m. programme. **9.15,** Starlight. **9.25,** Gaumont-British News. **9.35,** Cathleen Nesbitt and Niall MacGinnis in "The Shadowy Waters"; a verse play by W. B. Yeats. **10.15,** News Bulletin.

UNBIASED

By

FREE GRID

Misguided Ingenuity

AS a result of my recent note concerning the regrettable traits of character exhibited by the modern boy, I have received an intensely interesting letter from an examiner whose duty it is to make periodical investigations into the degree of knowledge or ignorance displayed by the rising generation. A year or two ago, he tells me, he and his colleagues were greatly heartened by the tremendous improvement in the standard of knowledge exhibited by modern youth. The answers to examination questions appeared to exhibit not only intelligence but also very precise knowledge. There was only one fly in the ointment and that was the appalling state of ignorance betrayed in connection with questions involving rather complicated mathematical formulæ.

The great discrepancy between the ignorance betrayed in certain branches of mathematics and the very precise knowledge exhibited in other matters eventually aroused suspicion. As a precautionary measure candidates for the next examination were widely separated and a strict watch kept but no attempts at communication with each other were detected nor were candidates seen to produce note-books from their pockets.

Eventually a very curious fact was observed and that was that all the highly successful candidates appeared to be afflicted with short-sightedness, as when writing their answers they all kept their heads glued closely to the examination papers. This caused several theories to be put forward to the effect that the answers to the questions were written in invisible ink on the examination papers, and the unfortunate printers immediately fell under suspicion.

The most careful chemical tests failed to reveal this, however, and the authorities were at their wits' end when suddenly the whole mystery was solved owing to the fact that one of the examiners was an ardent reader of this journal, and had constructed the Ultra-Short-Wave receiver described some time ago. Happening to be whiling away an idle hour in an anteroom while waiting to take his turn of duty, he was astonished to pick up morse code transmissions of the questions in the paper then being taken.

Quickly entering the examination room he found nothing unusual in progress, and the mystery would probably never have been solved had he not risked an action for assault and battery by suddenly seizing the nearest short-sighted candidate and tearing his outer garments from him. On the suspect was found a cleverly concealed low-powered U.S.W. trans-receiver, the morse key being in the youth's trouser pocket. The ear-piece was under the lapel of his coat and this, of course, explains the apparent short-sightedness, as the close application of the eyes to the paper on the desk brought the candidate's ear close up to the lapel of his coat.

Caught in the act.

The villain of the piece who was supplying the answers to the questions wirelessed to him in morse, was the man who looked after the central-heating apparatus. He was discovered in the stokehole with a similar trans-receiver and surrounded by a plethora of text-books. The reason why the ruse was not successful in certain parts of the mathematical paper was soon solved for after all it is difficult to send in morse a mathematical formula such as:—

$$\bar{j} = \frac{\pi e^2 F \tau}{m} \int \frac{\partial N_0}{\partial v} v^3 dv \left[\int_0^{\pi} \sin^3\theta d\theta - \int_0^{\frac{1}{2}\pi} \sin^3\theta d\theta \frac{1}{l} \int_0^{l} \exp\left(-\frac{z}{\lambda_0 \cos\theta}\right) dz - \int_{\frac{1}{2}\pi}^{\pi} \sin^3\theta d\theta \frac{1}{l} \int_0^{l} \exp\left(\frac{l-z}{\lambda_0 \cos\theta}\right) dz \right].$$

The Radio Industry Saved

I HEAR from reliable sources that my recent revelations concerning colour-blindness has caused consternation among set manufacturers. It may be remembered that after endless trouble with a home-made set I suddenly discovered that it was all due to the fact that I had unknowingly become colour-blind with the result that I was putting totally wrong values of resistances into the set owing to my inability to read correctly the colour coding by means of which the values are designated.

From information which has reached me I learn that as the result of my discovery certain manufacturers have at last discovered why such a high percentage of their sets have reached customers in a non-working condition. It is not a case of sets merely putting up a poor overall performance or being instable such as would be the case if the resistance values in anode and screening grid circuits were incorrect. Something far more serious has been occurring as sets have been refusing to function altogether and have been received back into the Service Department with burnt-out valves due to HT connections being made to heaters and suchlike things.

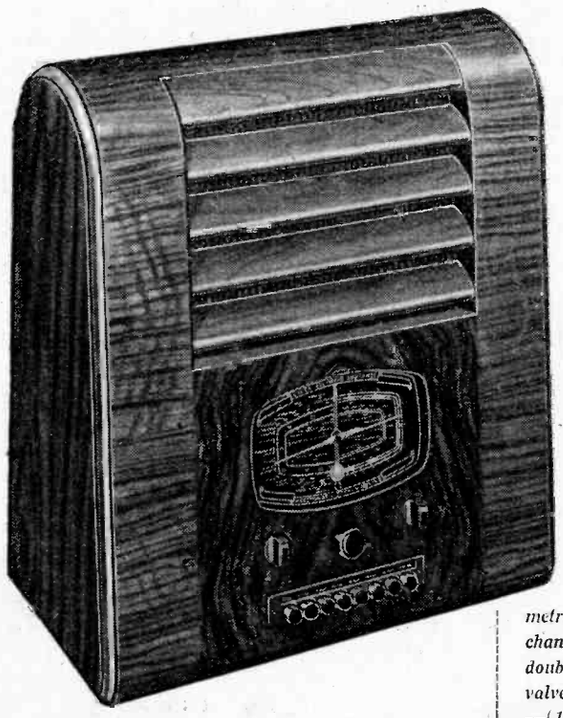
In many cases this has led to perfectly innocent members of the public being accused of invalidating the manufacturer's guarantee by tampering with the set, and the result has been that ill-feeling has been created all round. The trouble is that in many sets the various connections are also colour-coded in order to enable factory operatives to identify them quickly. It does not need a great deal of imagination to envisage the chaos that would ensue if only one or two of the factory staff, such as wirers-up and testers, were partially colour-blind. This, I understand, is exactly what has been happening.

The result is that certain firms are now hastily making special arrangements for all their staff to be tested for colour-blindness, while this test is to be very rigidly enforced in the case of all newcomers to the ranks. Needless to say, I am exceedingly gratified to have been able to be of some small service to the radio industry in drawing attention to this very grave source of trouble.

Colour-blindness is a very serious thing and on one occasion very nearly precipitated a war. As students of history will no doubt remember, during a certain South American revolution the flag of a non-combatant was fired upon owing to the unsuspected colour-blindness of a responsible executive officer on one of the belligerent battleships, who mistook it for that of the enemy which it somewhat closely resembled in pattern.

Consternation among set manufacturers.

If there are any of you who have built receivers "exactly to authors' specifications" and have unjustly blamed the designer for a failure to achieve the anticipated results, I should strongly advise you to get your eyesight tested. It is more than probable that colour blindness is at the root of the whole trouble, and it is the ordinary doctor rather than the radio doctor who should be consulted.



Decca PT/AC

Press-Button Selection of Seven Pre-tuned Circuits

FEATURES. ***Type.***—*Table-model superheterodyne with manual tuning or automatic selection of seven pre-tuned stations.* ***Wave-ranges.***—*(1) 19-49 metres. (2) 200-550 metres. (3) 1000-2000 metres.* ***Circuit.***—*Triode-hexode frequency changer—var-mu pentode IF amplifier—double diode second detector—pentode output valve. Full-wave valve rectifier.* ***Controls.***—*(1) Manual or press-button tuning. (2) Volume and on-off switch. (3) Wave-range. (4) Tone.* ***Price.***—*14½ guineas.* ***Makers.***—*The Decca Gramophone Co., Ltd., 1-3, Brixton Road, London, S.W.7.*

THIS was one of the first of the recent spate of sets with automatic tuning to reach the stage of quantity production. Both mechanically and electrically it is of simple and robust design, and the vital question of tuning stability is answered by a new design of trimmer in the pre-tuned station circuits.

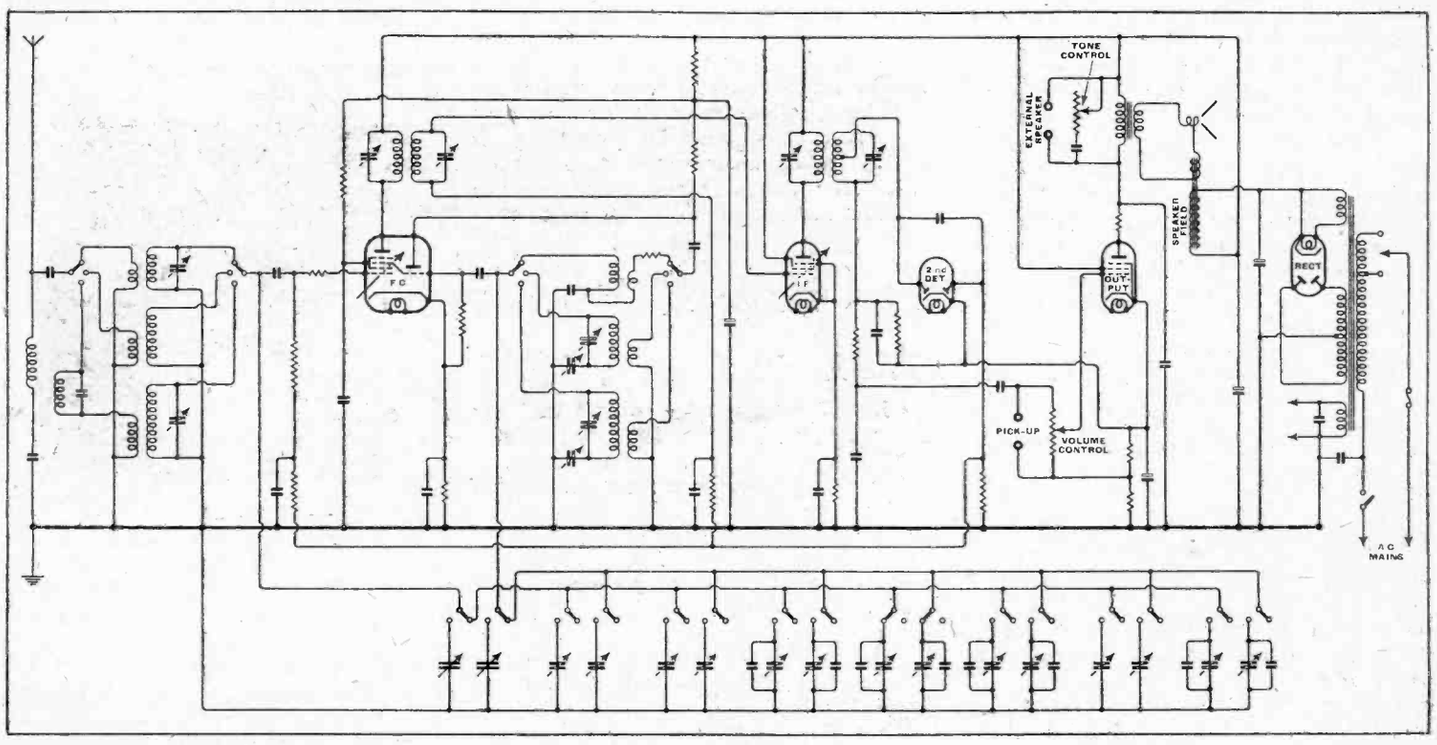
The basic circuit is a straightforward superheterodyne consisting of a triode-hexode frequency changer, variable-mu pentode IF amplifier working at 465 kc/s, double diode second detector providing AVC to the preceding valves on all three wavebands and a pentode output stage. Associated with the single-tuned aerial circuit is an IF filter and a 261-metre rejector to avoid whistles generated by oscillator harmonics on long waves.

There is little point in taking special precautions over the stability of tuning in the frequency changer stage if the IF amplifier is allowed to drift. Accordingly the ceramic trimmers are of the same stable type as those used in the RF circuits, and the iron-dust cores of the transformers are sealed in position.

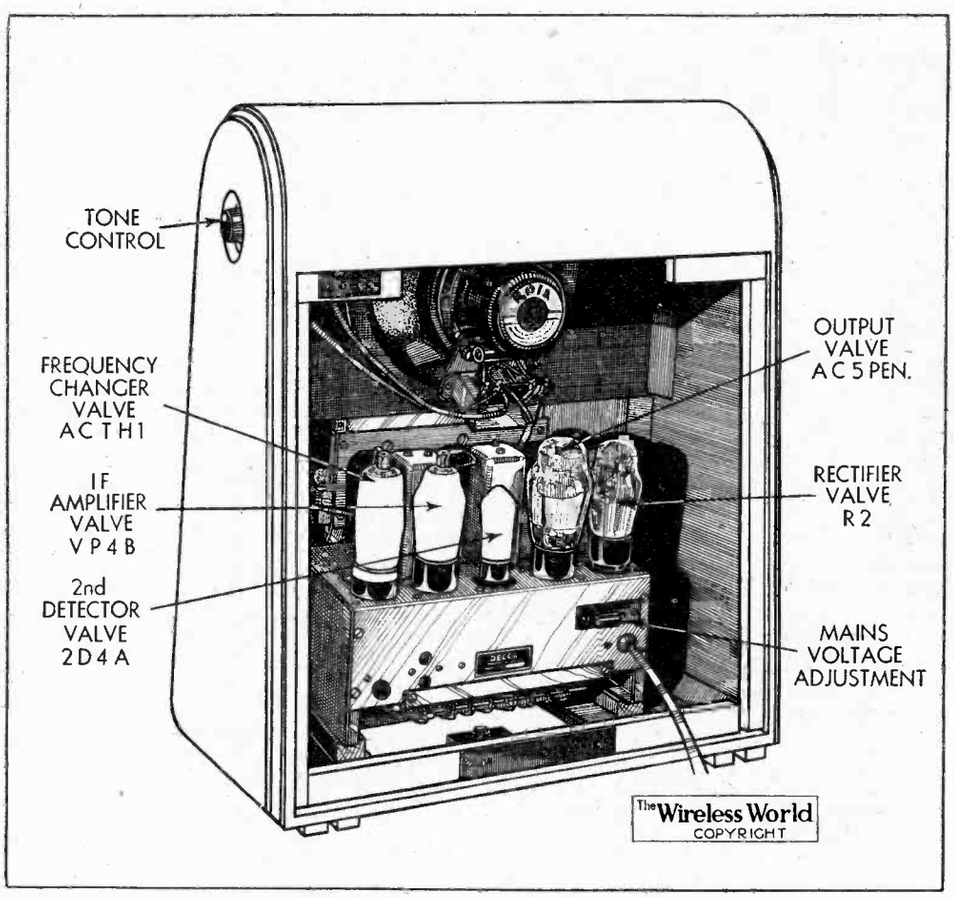
Instead of the conventional compression trimmers with mica dielectric, rotary trimmers with semi-circular electrodes are employed. Both the base and the rotating disc are of ceramic material ("Tempa") having a high dielectric constant and exceptional freedom from temperature changes, warping or moisture absorption. The electrodes are of silver, and the two halves of the condenser are held in contact by a spring washer, thus preventing all relative movement except rotation in a plane parallel to the electrodes. The capacity of the trimmers is quite small, and the tuning capacity is made up where necessary by fixed ceramic or silvered mica condensers.

Pairs of circuits for aerial and oscillator are provided for each of the stations selected by the seven press buttons. The multiple selector switch is of the trigger-bar type in which movement of any of the switch buttons lifts the bar and releases all other switches in the line. At the right-hand end is a double-pole switch button for changing from automatic to manual operation.

Strictly speaking, of course, this test report should extend over six months with periodical bulletins of the way in which the pre-set circuits are holding their tune; but it is reasonable to assume that such a test has already been made in developing the chassis. At all events every circuit was in perfect alignment when tested, and some considerable time had obviously elapsed since the set came off the makers' assembly line, for the



Complete circuit diagram showing individual tuned circuits and switching of "Prestomatic" station selector.



The automatic tuning device adds nothing to the size of the chassis and the cabinet is in fact shallower than that of the average table model.

Radio Normandie circuit and the dial marking were on the old wavelength.

When the set was first switched on the various B.B.C. regional stations occupying the first four buttons were all taking the same programme, and it was most instructive to change from one to another in rapid succession and to compare the results with the London Regional station tuned-in accurately with the manual control. In the first place there were no differences in quality which might indicate the creeping of one or other of the circuits towards the fringe of sidebands, and, secondly, the test paid striking tribute to the efficiency of the AVC circuits for there was hardly any change of volume. Except for slight differences in the character of the background noise, they might all have been the same station.

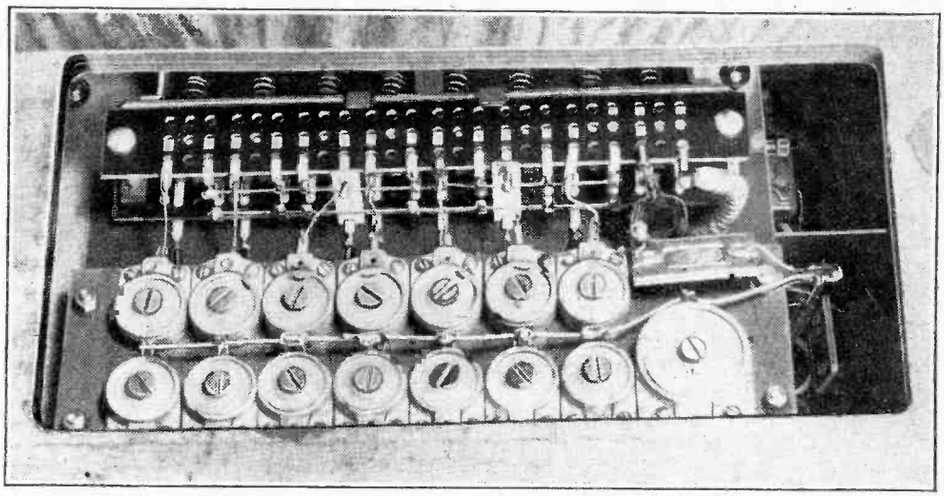
Droitwich and Luxemburg were the long-wave stations on the "Prestomatic" control, and here again no difference could be detected from the best results obtained with manual tuning. It is necessary to move the waverange switch before the latter stations can be received, but this is no great hardship—at any rate it is less trouble than tuning manually. It should be emphasised that the stations mentioned are not the only ones that may be included in the automatic control. Each trimmer has a range of adjustment that overlaps its neighbours, and the service man can easily provide an alternative choice of stations or readjust to changes of wavelength at any time.

Used as a normal broadcast receiver the set shows itself to be a lively performer on all three wavebands. Self-generated whistles are absent on the medium waveband, but a few of no great strength were to be found on long waves and near the bottom of the short-wave range. They in no way interfere with the usefulness of the receiver for long-distance reception on short waves.

Selectivity on medium waves is equivalent to the loss of two channels on either side of the London Regional station at a distance of 15 miles, and on long waves gives easy separation of Droitwich and Radio Paris, but with a gap hardly wide enough to let through the Deutschlandsender as a station of programme value.

The cabinet is of unconventional design, and its tapering depth from back to front effectively suppresses all trace of box resonance. The wooden slats bridging the loud speaker opening slant downwards and prevent useless radiation of high frequencies upwards without affecting the forward response. There is no fault to find with the general reproduction on all types of transmission, and the lack of the customary table-model bass is not necessarily a disadvantage. The maximum acceptable volume was estimated at the equivalent of 2½ to 3 watts.

The "Prestomatic" trimmers are readily accessible by removing a panel in the base of the cabinet, but it is unlikely that they will require expert attention except for alterations in station wavelengths. These trimmers certainly look the part, and their performance seems to amply justify the makers' choice.



View of ceramic trimmers and selector switch as seen through inspection aperture in base of cabinet.

CLUB NEWS

Exeter and District W.S.

Headquarters : 3, Dix's Field, Exeter.
Meetings: Mondays, at 8 p.m.
Hon. Sec.: Mr. W. J. Ching, 9, Sivell Place, Heavitree, Exeter.

At the last meeting a lecture entitled "Measuring Instruments" was given by Mr. Rich, of the Mullard Co. The lecturer gave practical demonstrations on several instruments, including a cathode-ray oscillograph, a frequency modulator and a measuring bridge.

Surrey Radio Contact Club

Headquarters : The Alhambra, Wellesley Road, Croydon.
Meetings : First Tuesday in the month.
Hon. Sec.: Mr. A. B. Wiltshire, 14, Lytton Gardens, Wallington.

At the April 5th meeting Mr. Pickard, of Webbs Radio, gave a lecture followed by a demonstration of modern American communication receivers. The receivers demonstrated were the new model of the Sky Challenger II and the RME 69LSI, both of which were fitted with crystal gates. The Harvey UXHro transmitter and the New McElroy Straight key were also demonstrated.

On May 3rd there will be a sale of surplus gear. The programme for the summer includes a television demonstration, a talk by a well-known VQ4 amateur and a social outing.

"....Not as Other Men!"

By "CATHODE RAY"

TRIALS OF THE QUALITY ENTHUSIAST

ADVERTISEMENTS are very entertaining these days. I have been amused by the young lady who has cancelled all her invitations to stay with friends because her home is now so well warmed that she can no longer tolerate any other. No doubt the advertising managers of radio businesses are kicking themselves for not having thought of this first. For when you come to think of it there is nothing to which it applies better than to radio.

If you are a quality enthusiast, have you not found yourself developing an anti-social tendency? The nearer perfection you get with your own equipment, the more painful it is to endure your friends' radio. What they chat or knit or play bridge to, presumably with pleasure and satisfaction, is to you like the wailing of midnight cats and the squealing of oilless machinery. If you allow your natural instincts full play with regard to this, you gain a reputation for being unpleasantly superior and critical, at least; or at worst, for being a dangerous and destructive maniac. If you curb these instincts you will be considered morose and taciturn. While if, either as a result of the foregoing or in an effort to escape from aural torments, you refuse all social visits, attend no football matches, speedways, political meetings, or other places where doubtful amplifiers may be used, and even cut out the local cinema, then you will be described as a hermit.

"To endure your friends' radio."

The alternative is to give up the search for high fidelity and be content with an "ordinary" standard of reproduction yourself. But I must not call this article "The Flight from Quality," and give the impression that I really mean it, because then its passage to the Editor's WPB would be swift and uncompromising. For although I am, so to speak, only the cousin of the deputy semi-permanent Under-Secretary's typist in the Ministry of Fisheries and Agriculture (known in some circles as Fish and Chips) I must never forget that my lightest word in these columns is liable to be mistaken for an official statement of the Policy of the Government. So I must expressly make clear that it is nothing of the kind. The fact is that I, and probably most of my Great Public (if any), have found the last few efforts since the start of 1938 rather tough going; and this is by way of being a little relaxation to restore the worn tissues of the brain by indulging in some gentle exaggeration of the possible results of pursuing too relentlessly the ideal of perfect reproduction.

Missionary Work

To prove the absurdity of drawing the conclusion that I am discouraging efforts to reach a high standard of quality, it is only necessary to appeal once more to the advertisement that supplied the inspiration for these reflections. Would a firm advertise with the object of discouraging the use of its products?

No; presumably the idea is that the charm of the young lady's presence will be so missed among the circle of her acquaintance that they will begin to make tactful enquiries about the cause of her staying at home; and if she is as charmingly free from dissimulation as most modern young ladies she will reply, "Because your house is so —— cold!" Whereupon they will all enquire about the heating system used by her and install same.

Similarly, you, the connoisseur of quality, ought to bring your friends to a realisation of the depths of depravity to which their senses of hearing have sunk by being drugged to bad quality, as Sir Noel Ashbridge popularly put it. There is no doubt that the general standard of sound reproduction is bad. For evidence, one has only to think of the popularity of Continental sponsored programmes. Of course, if these programmes are considered by the people to be so inherently desirable as to be worth any amount of distortion, the case seems hopeless, for it would be a sinful waste of money to listen to them on a high-quality set. And over-modulation has commercial advantages as regards service area.

But assuming that these stations will be compelled to broadcast only in their own languages, or that the B.B.C. starts a patent medicine sideline to pay for the television service, or that the ears of the masses are educable, there is some faint hope of being able to improve the standard of sound reproduction.

Why is it bad now? Apart from those who lay the chief blame on the sponsored programmes, some say because the manufacturers would like to make high-quality sets, but have to supply what the public demands. Others say that the public demands just what the manufacturers educate it by their advertisements to demand. Probably the real reason is made of all these and some others, such as sidebands and wage cuts and feminine intolerance of baffle area, and so forth. Still, after all allowances are duly allowed, how many of your friends living in baronial halls, rolling in wealth and lolling in idleness, enjoying the fine things of life, looking down their aristocratic noses on every daily paper at exclusive brands of whisky and champagne, and telling you they are not *really* fussy, have in the corner of the room a wretched little box of radio, the cheapest "Manufacturer's surplus" line ever imported into the country? Instead of gritting your teeth and putting on a hypocritical smile of assent when they turn it on and say "Not bad, eh?" take a deep breath and tell them exactly what you think of it, and why. And explain that if they do not wish to lose you, their oldest fellow-cad, they must do something about it before they ask you over again.

Beyond Reproach?

I have been taking for granted that you, the expert, can clinch the argument by demonstrating *real* quality. There is, however, a proverb about shoemakers' children. And I have a guilty recollection of having admitted lately that I listen with an eight-year-old receiver. But just as it is a strain on the health, comfort and temper of an American to emerge from his central heating to visit Britain, so it would be running serious risks to accustom myself to ultra-perfect double-superfine extra-high-fidelity sound reproduction. For, you see, it falls to my lot from time to time to test and report on mass-production receivers prior to manufacture. I mean to say, a reader employed by the publisher of the Bloodstain Library of Long Complete Thrilling Romances would soon get himself into trouble if he accepted nothing of a lower literary standard than that of Shakespeare. But you, who are free from sordid commercial trammels, can assure your friends that it is not they whom you have ceased to love, but their radio; and perhaps give them some effective advice on what to do about it.

Television Topics

SINGLE-VALVE OSCILLATORS

WHEN a hard-valve is used for discharging the condenser in a saw-tooth oscillator it is necessary for its grid potential to be changed in a positive direction as soon as the discharge commences. It is also necessary for the grid to be driven negatively as soon as the condenser is discharged. Unless this is done the system is incapable of maintaining oscillations.

With the hard-valve circuits recently discussed this action was achieved with the aid of an additional valve. This is not essential, however, and it is often possible to replace it by a transformer. The circuit then takes the form shown in Fig. 1. The valve has a certain negative grid bias due to the average anode current flowing through R1; the anode current is actually pulsatory, but the use of a large capacity condenser C1 across R1 enables an almost steady voltage to be maintained across this resistance.

Starting with C discharged, it charges through R, and the anode voltage of the valve rises. All this time the valve passes no current, but at length the voltage rises sufficiently to start anode current, and this current flows through the primary of the transformer, thus causing a voltage to be induced in the secondary. If this secondary is connected correctly the induced EMF changes the grid potential in a positive direction, thus increasing the anode current and further increasing the grid potential.

The anode current is supplied by the condenser and its voltage consequently falls. Therefore it at length becomes too low to maintain the current and the anode current commences to fall. The falling anode current through the transformer primary induces an EMF in the secondary in such phase that the valve grid is driven negative, thus making the anode current still smaller until the valve ceases to pass current. The condenser C then commences to charge again and the cycle is repeated.

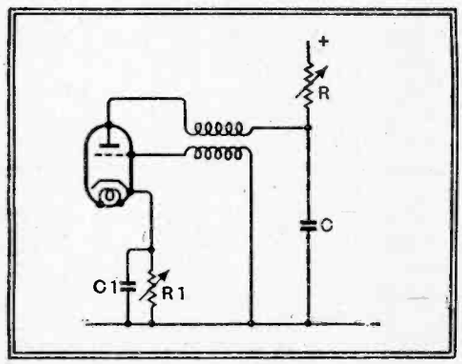


Fig. 1.—One of the simplest single-valve saw-tooth oscillators is shown here.

This action is only obtained with careful design of the transformer, for it can work in a somewhat different manner. It can be seen that the circuit is similar to that of an ordinary oscillator if we remember that both primary and secondary have a certain self-capacity and have the valve capacities in shunt with them. With certain circuit values it will actually operate as an ordinary oscillator and give an approximation to a sine wave output. With other values it will generate a saw-tooth waveform, but instead of operating as described above the valve will oscillate at a frequency determined by the transformer during the condenser discharge period.

Starting as before with C discharged, this condenser charges until the anode voltage is sufficient to start the anode current. The valve then oscillates at a high frequency until the condenser is discharged to such a degree that the anode voltage is insufficient to maintain oscillation. This is quite possible, for it is well known that the conditions for the starting and stopping of oscillation are not always the same—if they were there would be no "overlap" in a reacting detector.

The success of this saw-tooth oscillator depends chiefly upon the design of the transformer. For the frame frequency the writer has used a cheap AF transformer and for the line a super-regenerator quench coil with reasonably good results. It is, however, very important that the transformer be properly damped. In general, a resistance should be connected across the primary, and the lower its value the better is the performance of the circuit. If it is too low, however, the circuit fails to work at all. The optimum value must be found experimentally for the particular valve and transformer used; it is generally in the neighbourhood of 5,000 ohms at frame frequency, however.

It is quite easy to get the circuit to work at frame frequency, but it is more difficult at line frequency. The coils are more critical and the damping must be just so. Sometimes a resistance shunt to the secondary is better than one on the primary, but sometimes both are needed. Rather better operation is secured by arranging the circuit in the modified form of Fig. 2, but this has the disadvantage of requiring a special heater winding for the valve unless the heater-cathode insulation is good enough to withstand the high peak voltage. The difference in this circuit is that it is the cathode potential which is varied rather than the anode potential, and as a consequence the anode and grid potentials are varied simultaneously with respect to the cathode.

As before, start with the condenser discharged. The cathode is then at the potential of positive HT, which is also the anode potential. The grid is very considerably negative, being returned to the slider on R1, consequently the valve

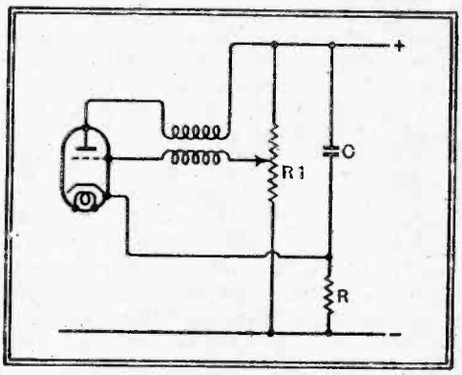


Fig. 2.—A modification of Fig. 1 which is often less convenient but which sometimes leads to a better performance is shown in this diagram.

passes no current. As the condenser charges the cathode steadily moves negatively with respect to positive HT; consequently it becomes more negative than the anode and comes nearer to the grid potential. In effect, the anode voltage rises with respect to the cathode and the grid potential moves nearer to that of the cathode.

When the potentials are such that anode current flows the action is the same as before. In fact, the only difference at any time is that the grid potential changes with the anode potential, reckoning both with respect to the cathode. This does, however, make for a more positive action.

With either of these circuits synchronising can be effected by arranging for the sync pulses to drive the valve grid positive just before its own discharge action would commence. One way of injecting the pulses is by means of a third winding on the transformer or a resistance of a few hundred ohms can be included in series with the earthy end of the secondary and the pulses applied through a condenser to the junction of the transformer and resistance. If a damping resistance is used on the secondary the pulses may be fed into a tapping on this resistance.

THE WIRELESS INDUSTRY

THE Keates-Hacker Co., Ltd., 91-93, Bishopsgate, London, E.C.2, have produced an attractive catalogue containing, in addition to a technical specification of their latest 19-valve chassis, a series of photographs illustrating typical cabinet designs in relation to furnishing schemes of diverse character.

The Jewel Pen Company, of 21-22, Great Sutton Street, London, E.C.1, wishes to draw attention to the fact that the "Red Diamond" crystal detector is still being manufactured.

B.B.C. HIGH FIDELITY TRANSMISSIONS

Toscanini Concerts on Ultra-short Waves?

OWNERS of ultra-short wave sets in the service area of the London Television station may soon have their first opportunity of receiving high fidelity transmissions of the National programme. If arrangements, now in hand, fructify, a series of relays on 7.23 metres of the Toscanini concerts in the London Music Festival will be transmitted. Excerpts from the first part of each of the six concerts are planned, beginning at 8.15 and continuing until approximately 9 p.m., when the normal television programme begins.

No more auspicious start could be chosen for this long-awaited experiment the need for which has frequently been stressed by *The Wireless World*. Arturo Toscanini is recognised as the world's foremost conductor, and the Maestro has himself stated that the B.B.C. Symphony Orchestra is in the front rank. A concert by such an orchestra under such a conductor, reproduced on ultra-short waves, with the wide band of frequencies which they make available, would provide a musical treat and a splendid opportunity for the connoisseur of high-quality reproduction.

If the experiment is tried, there can be little doubt about its success, and it is probable that a regular series of seven-metre relays may be inaugurated, creating a new market for high-fidelity receivers. The quality of the sound in the television transmissions has already evoked widespread praise from musicians, many music critics of the programmes from Alexandra Palace having been tempted to ignore the visual side in their eulogies of the sound.

SCOTTISH NATIONAL POWER INCREASE?

The Result of a Deputation

SIR NOEL ASHBRIDGE has cheered the hearts of six thousand Dundee listeners by his promise, at long last, to increase the field strength of the Scottish National transmitter in Fifeshire. The Chief Engineer of the B.B.C. gave this undertaking on April 11th, when a deputation of local radio traders, accompanied by Major Peter, Chairman of the R.M.A., and several Members of Parliament, visited Broadcasting House. The main burden of complaint, which was voiced by a local trader, Mr. E. J. Allan, was that the Westerglen transmitter fades badly after dark and is also subject to local interference. The first step will be to effect aerial adjustments with the possible introduction of reflectors; if this is still unsatisfactory the Scottish National transmitter power may be increased.

SWEDISH WIRED WIRELESS

DESPITE the construction of several high-power transmitters in Sweden, the quality of reception is still poor in many Swedish localities, chiefly owing to the mountainous nature of the country. With a view to combating this difficulty a wired wireless system installed by the Government has been tried out in Karlshamn, with great success. It is now proposed to introduce the relay system in Stockholm.

NEWS OF

WIRELESSMAN'S BADGE

Proficiency of Boy Scouts

THE Boy Scouts Association has remodelled the conditions for obtaining the Wirelessman's proficiency badge. These conditions may interest readers, and their comments will be welcomed by the Boy Scouts Association.

To obtain this badge a boy must: (1) have an elementary knowledge of how a thermionic valve works as an HF amplifier, detector and LF amplifier, and how a Westector works; (2) know the functions of condenser, resistance, inductance, reaction and mains rectifier transformer; (3) know how to cure hum or how to build a cheap mains eliminator; (4) know how to locate and cure a simple fault in a receiver; (5) show a working knowledge of moving-coil loud speakers; (6) draw a simple diagram showing how to connect up a resistance capacity coupled stage and an LF transformer, and show a knowledge of the principles involved; (7) read a technical diagram and interpret the symbols; (8) have assembled a simple receiver and know all the distress signals; and (9) know the methods of charging and looking after accumulators.

VOTES FOR VARIETY

MIDWAY through the B.B.C.'s twelve-week survey of the Variety Listening Barometer, the 2,000 log-keepers in all parts of the country answered a special questionnaire which asked them to indicate their views on the quantity of each of ten types of variety broadcasts. The results, which provide useful comparisons between the popularity of different types of variety programmes, are as follows:—

Types of Programme.	Percentage who —would like more.	—would like less.	—are satisfied.
Straight Variety	70	1	29
Reginald Foort at the B.B.C. Theatre Organ	55	5	40
Comedy Shows	54	5	41
Concert Parties	44	8	48
"Interest" Features	41	7	52
Cinema Organs	41	8	50*
Serials	31	12	56*
Musical Comedy	29	19	52
Dance Music	17	28	54*
American and Foreign Relays	8	57	34*
Average	39	15	46

(* 1 per cent. did not reply.)

GLASGOW CHANGE-OVER

A CHAPTER in Scottish broadcasting history will be closed on May 14th with the final transmission from the old Glasgow studios in Blytheswood Square. The first programme from the new studios in the Botanic Gardens is scheduled for Sunday, May 15th.

The original Glasgow studio, which was in a comparatively squalid apartment in Cross Street, was inaugurated with the opening of 5SC on March 6th, 1923, on the top floor of the Corporation power station at Port Dundas. The move to Blytheswood Square was made in November, 1934.

TELEVISION AT THE I.E.E.

TWO important papers were read at the Institution of Electrical Engineers last Thursday, April 21st. One, by Messrs. T. C. Macnamara and D. C. Birkinshaw, described the London Television Service, and the other, by Messrs. Blumlein, Browne, Davis and Green, dealt with the Marconi-E.M.I. Television System.

Probably the most interesting section of the latter was that dealing with the reason for the choice of the particular transmitted waveform. The type of scanning, duration and amplitude of sync pulses, the advantages of positive and negative modulation were all discussed.

In other sections the generation of the various scanning and pulse frequencies was treated as well as the "bend" and "tilt" signals needed for camera correction. The transmitter itself was considered with particular reference to the special problems of television which necessitated for their solution the use of "cathode-followers" in the coupling stages and the extensive adoption of constant impedance networks.

AT THE I.E.E. meeting held last Thursday while A. D. Blumlein was reading his section of the paper on the Marconi-E.M.I. Television System. The papers, which were delivered to a large gathering, were a most valuable record of present progress and the E.M.I. engineers deserve the highest praise for their work in preparing them.

THE WEEK

NEW HOLLYWOOD BROADCASTING HOUSE

CIVIC, State, and national dignitaries from all over the United States will be present on April 30th at the opening ceremony of the Columbia Square Headquarters of the Columbia Broadcasting System in Hollywood.

Transmissions, which will begin at 3 p.m. B.S.T., are to be radiated by the entire network and should be well received in England from the C.B.S. international short-wave station W2XE.

The entertainment side of the dedicatory programmes will be supplied by famous radio and film artistes, and the atmosphere of the occasion is to be musically interpreted in a new work, "Slidin' Down a Kilocycle to Columbia Square."

VISUAL CHECK ON TELEVISION

"FREE GRID," on a celebrated occasion, drew attention to a discrepancy between an alleged O.B. from a country church belfry that he had picked up on a portable receiver, and the actual sounds which came to his ears from the church itself, only a short distance away.

A similar test, with vision instead of sound, revealed no such discrepancy when a Dulwich (South London) televiewer tuned in the "air raid" which was televised from Alexandra Palace on Easter Monday. From a window fourteen miles from the scene of action he was able to watch the searchlight beams obeying the orders which he could see being carried out on the television screen at his elbow. This is believed to be the first occasion on which a viewer has been able to apply a direct visual check to the picture on the television screen.

R.A.F. RADIO SOCIETY

THE objects of the recently formed R.A.F. Amateur Radio Society are to encourage and assist members in private experimental work with high-frequency apparatus. Serving and past members of the R.A.F. and civilians connected with the Service may become associate members.

This organisation has sprung from the Cranwell Amateur Radio Transmitting Society (CARTS), which was formed by several amateur transmitters meeting fortuitously at the Electrical and Wireless School at Cranwell. The "CARTS" transmitter, G8FC, is well known throughout the Empire.

AS OTHERS SEE US

ON his return to the States from a recent European tour Mr. E. K. Cohan, the Director of General Engineering for the Columbia Broadcasting System, reports that he was somewhat disappointed in the public response to television in England, the country which, as he says, is admittedly in advance of other nations in that field. While the B.B.C. engineers are making highly satisfactory advances, he feels that the public seems to be just curious rather than evincing a real programme interest in television.

SHORT WAVES IN INDIA

AS the result of the introduction of short-wave transmissions in India, large numbers of medium-wave wireless receivers have been rendered obsolete. Suitable converters which enable old sets to receive these transmissions have been placed on the market, and new all-wave receivers are in great demand by an enthusiastic if somewhat disgruntled public.

EMPIRE BROADCASTING

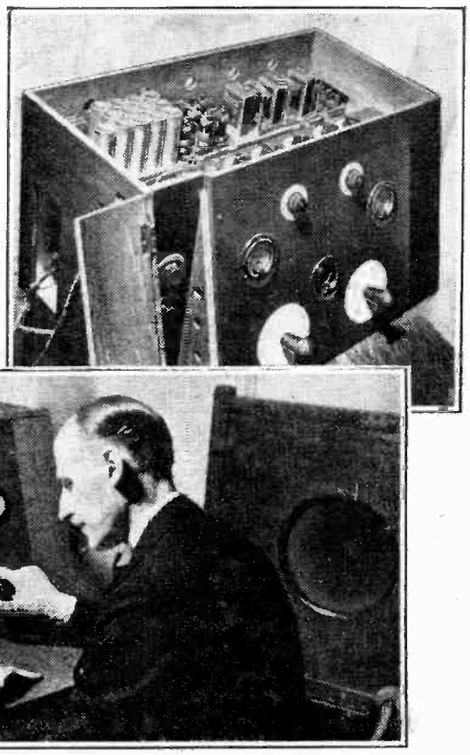
THE history and technical development of Empire Broadcasting, the foundations of which were laid in 1927 with the establishing of G5SW by the Marconi Company at Chelmsford, are interestingly reviewed in a new B.B.C. publication, "The Empire Short-wave Station, Daventry." A detailed technical description of the present station, giving, among many interesting features, a plan of the aerial arrays, is also included in this well-illustrated little booklet.

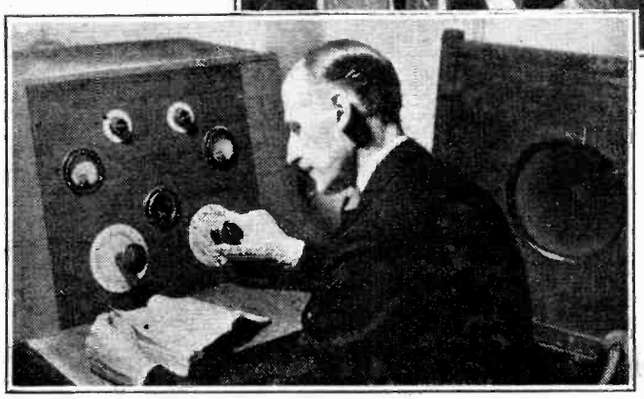
GERMAN DIALECT MEMORIAL

HERR HITLER was, some time ago, presented with a collection of gramophone records of about three hundred German dialects by the Association of German Civil Servants. This collection is housed in a special cabinet in the Führer's house at Berchtesgaden. A second cabinet is kept by the Propaganda Ministry at Berlin.

The Association has now requested Telefunken to add Austrian dialects to the collection, and the special recording car used for the first series will shortly start on a tour through Austria.

The official title of the collection, which cannot be purchased by the public, is "The Memorial in Sound of German Dialects at the Time of Adolf Hitler."





THE MIXING of two ribbon microphones on the stage and one in the orchestra pit at Covent Garden, will be effected this year, for the first time, from one of the Grand Tier Boxes. This will enable the "mixing" expert to follow the movement of the singers; he will also follow a complete score of the opera. During rehearsals, experiments will be made with uni-directional microphones. The pictures show the control point, which last year was installed under the stage. The controls at the bottom of the panel are for orchestral and stage microphones and those at the top are for echos; in the centre is the programme meter. The first relay takes place on Monday evening.

FROM ALL QUARTERS

The Empire Exhibition

H.M. THE KING will be heard from all B.B.C. transmitters, except London and North Nationals, on Tuesday next, May 3rd, when he opens the British Empire Exhibition at Bellahouston Park, Glasgow.

B.B.C. News Bulletins

REFERENCE was made in our issue of March 3rd to the pending agreement between the B.B.C. and the Newspaper Proprietors' Association. This has now been signed and, as previously stated, the main change is that the Corporation will now be free to obtain news from sources other than the four agencies as heretofore.

"The Luxembourg Listener"

THIS is the name given to the plane which has inaugurated a regular air service from England to the Duchy of Luxembourg started by Wireless Publicity, sole British Empire agents for Radio Luxembourg, thus facilitating the shipping of programme materials and artistes to that station.

Radio Research

AT the next meeting of the Wireless Section of the I.E.E., to be held at Savoy Place, London, W.C.2, at 6 p.m. on Wednesday, May 4th, Dr. Ralph Bown will lecture on "Researches in Radio Telephony."

Amateurs and A.R.P.

A SUGGESTION to enrol Great Britain's 2,000 amateur transmitters to give the nation warning of impending air raids was made by Major Morgan, a member of the Glamorgan County Council A.R.P. Committee. It is interesting to note that the amateurs of this country have several times offered their services to the Home Office as a corps of emergency operators, but no definite official plan has so far emerged.

Pitcairn Calling

SIGNALS from the new station on Pitcairn Island, of "Mutiny on the Bounty" fame, are being regularly received by Mr. George Brown, a radio pioneer at Birmingham. The signals are heard between 6 a.m. and 9 a.m. on a frequency of 14.343 Mc/s.

Whitehall Wireless

IT is reported in the *Daily Telegraph* that although the British Consul in Valencia is no longer able to communicate overland through Barcelona and France, he is keeping in touch with Whitehall by means of a private wireless transmitter.

Football Club Transmitter

A SPECIAL USW transmitter has been installed in the stadium of the Kobenhavns Boldklub, a Copenhagen football club. It will radiate running commentaries on all major sporting events, transmissions being picked up by the official broadcasting authorities and re-radiated over the ordinary networks.

Ship-to-Shore Telephony

THE problem of providing ship-to-shore telephony at Glasgow Docks was referred to three members of the Glasgow Chamber of Commerce. They have approached the Clyde Trust on the subject, but as yet without result.

RANDOM RADIATIONS

By "DIALLIST"

Receiving "Long-Short" Wavelengths

AN ingenious method of improvising means for receiving short-wave stations on a superhet not designed for "all-wave" reception has been described by "Trouble Shooter" in recent issues of *The Indian Listener*. As readers may recall, a large part of India relies for its evening programmes on the short-wave transmissions of Bombay and Delhi. The former gives its evening programme on 3,305 kilocycles (90.77 metres). The adoption of this wavelength revealed two weaknesses in receiving sets. Many covered either the medium waves and the long waves or the medium waves only, whilst most of those of the "all-wave" type would not tune up to 90 metres on their short-wave range. Naturally, there was considerable grousing, for it seemed that the great majority of the sets in use in places outside the medium-wave service area of the station were automatically rendered obsolete by the adoption of this long-short wavelength. But the gallant "Trouble Shooter" stepped into the breach, describing a way of receiving Bombay on a two-band superhet by making use of the second harmonic of the oscillator.

Interesting Figures

Here is the way in which he set to work. Most, if not all, sets are so arranged that the oscillator is working at a higher frequency than that of the incoming signal. If the intermediate frequency is 456 kc/s the oscillator frequency is thus 1,880.5 kc/s when the tuning indicator points to 1,424.5 kc/s, or approximately 212 metres. The second harmonic of the oscillator is 3,761 kc/s, which beats with Bombay's 3,305 kc/s to produce the IF of 456. It is, of course, necessary to by-pass any signal-frequency stage, and this is done by connecting the aerial to the trimmer of the frequency-changer grid-tuning condenser with the aid of flex and a crocodile clip. So long as the IF of the set lies between 450 and 470 kc/s, as nearly all IFs do nowadays, Bombay is found with the set apparently tuned to the neighbourhood of 212 metres.

Even Third Harmonics !

The method was also worked out for Delhi, which was then operating on a neighbouring channel. But no sooner had that been done than Delhi most disobligingly changed its frequency to 4,905 kc/s (60.1 metres). Undismayed, "Trouble Shooter" girded up his loins once more and found that in places not over-far from Delhi the 60.1-metre transmission could be received by means of the third harmonic of the oscillator with the set tuned to about 227 metres. The third harmonic is, however, usually rather feeble and reception by its aid will probably seldom be found to be of great practical value. It occurs to me that readers might find it interesting to experiment with the second-harmonic method, choosing times in the small hours when the medium-wave band is pretty quiet. It may, for instance, be possible to bridge in this way the gap between 100 and 200 metres that exists in most receivers. Suppose, for example, that we tune the set to the normal setting for Radio-Mediterranée on 1,276 kc/s, we should be able to get down to approximately 100 metres. When the signal frequency is 1,276 that of the oscillator, assuming an IF of 456, is 1,732 kc/s. The second harmonic of this is 3,464, which beats with 3,008 kc/s to produce the intermediate frequency of 456. Or, again, by making use of this second-harmonic principle on the short-wave range of an "all-wave" set it may be possible to tune, after a fashion, up to frequencies far beyond its normal scope.

For D—X Fans

WRITING of radio in India reminds me that the new Lucknow transmitter was opened by the Government of the United Provinces on April 2nd. Lucknow has a 5-kilowatt plant and operates with the call-sign VUW on 1,022 kc/s, or 293.5 metres. At present it is giving an evening programme only, from 6.30 to 11 p.m. Indian Standard Time, which is four and a half hours fast of British Summer Time. From our point of view, therefore, Lucknow is on the air from 2 p.m. to 6.30 p.m. Whether any of our dyed-in-the-wool D—Xers will succeed in logging VUW I don't know, though I doubt it. Lucknow's call-sign, by the way, is the first to break the rule that those of All-India Radio stations consist of the letters VU followed by the initial of the town—VUB, Bombay; VUC, Calcutta; and so on. Lucknow had no option since VUL had already been appropriated by Lahore.

Fun With the Wireless Set

WHEN I first heard about motor-tuned receivers which brought in the station that you wanted for the mere pressing of a button, I was rather disposed to place them in the category of stunts likely to appeal chiefly to those who don't take wireless very seriously. For the last day or two, however I have been using one of them, and I must really admit that this kind of tuning is a distinct addition to the broadcast receiver's good points. You can, of course, use manual tuning whenever you want to on the medium waves and the long waves, and you have to do so to tune in short-wave stations. Hence you can tune the set in the good old-fashioned way when you are seeking for those smaller and more distant stations that are the joy of the long-distance man's heart. But it's great fun to be able to tune in any one of a useful selection of strongly received stations by just touching the appropriate button. Not the least fascinating part of the business is watching the pointer travelling round all

Broadcast Programmes

FEATURES OF THE WEEK

THURSDAY, APRIL 28th.

Nat., 7.20, The Band of H.M. Royal Rifle Corps. 8, Variety from the Holborn Empire. 8.40, "Transport"—I, Talk by Basil Marsden-Smedley. 9.20, Talk on the Budget by Sir Archibald Sinclair.

Reg., 6, "Scrapbook for 1928." 8, A Sound Impression of the Empire Exhibition in the Making. 8.40, Rhythm Express.

Abroad.

Leipzig, 7.30, "Othello"—opera (Verdi).

Bucharest, 7.35, "The Valkyrie"—opera (Wagner).

FRIDAY, APRIL 29th.

Nat., 7.30, Ralph Reader Revue No. 3. 8.15 "Banging the Big Drum"; the story of publicity ancient and modern. 9.20, Talk on the Budget by Mr. J. Colville, M.P.

Reg., 7.30, Frank Mannheimer, pianoforte. 8, "Madam Butterfly," Act 1 of Puccini's opera from Sadler's Wells. 9.30, Duke Ellington and his Orchestra, relayed from New York.

Abroad.

Vienna, 7.30, "Turandot"—opera (Puccini).

Hamburg, 8.10, "The Bird Fancier"—operetta (Zeller).

SATURDAY, APRIL 30th.

Nat., 1.10 and 4.45, Cricket Commentary; the Australians *v.* Worcestershire. 2.30, Commentary on the F.A. Cup Final, Preston North End *v.* Huddersfield Town. 9.20, American Commentary. 9.45, Mr. Winston Churchill will propose the toast at the Royal Academy Banquet.

Reg., 3.55, Ralph Reader Revue. 8, Backstage at Bellahouston. 9, B.B.C. Ballroom.

Abroad.

Bucharest, 7.35, "Siegfreid"—opera (Wagner).

SUNDAY, MAY 1st.

Nat., 9.30 a.m., Emilio Colombo Octet. 10 a.m., Military Service from York Minster. 7, Songs of the British Isles. 9.50, Josef Hofmann, pianoforte.

Reg., 6, Round the Courts. 6.40, "Old Bannerman"—play. A Voyage in the West Indies sixty years ago. 9.50, Spelling Bee.

Abroad.

Berlin, 8, May Day Gala Programme.

Rome, 9, Berlin Philharmonic, from Teatro Vittorio Emanuele, Florence; conducted by Furtwangler.

MONDAY, MAY 2nd.

Nat., 1.15 and 5.45, Cricket Commentary; the Australians *v.* Worcester. 7, Monday at Seven. 9.20, World Affairs.

Reg., 6.30, Swift Serenade. 7.55, Covent Garden Opening Night; "Magic Flute," Act 1. 9.15, Eddie Carroll and his Orchestra.

Abroad.

Lille PTT, 8.30, Concert of French Music from Valenciennes Conservatoire.

Milan, 9, Berlin Philharmonic, from Florence.

TUESDAY, MAY 3rd.

Nat., 10.45 a.m., H.M. the King opens the Empire Exhibition at Bellahouston. 8, "Forty-Second Street," an adaptation of the film success. 9.20, America Speaks.

Reg., 7.30, Fred Hartley and his Swing Strings. 8.20, Midland Parliament—"Industrial Welfare." 9.10, "Night Out"—Tour of the Empire Exhibition at Night.

Abroad.

Brussels I, 8, Russian Concert with the Russian Choir of Brussels.

Eiffel Tower, 8.30, Concert of Music by modern European Composers.

WEDNESDAY, MAY 4th.

Nat., 7.40, Act 1 of "Der Rosenkavalier" from Covent Garden. 9.20, The Trial of Katharine Nairn—Edinburgh, August, 1765.

Reg., 3.10, Commentary on the Chester Cup. 6.40, From the London Theatre. 7.30, The World Goes By. 8, Band Waggon.

Abroad.

Leipzig, 8, Concert of German Folk Dances.

Paris PTT, 8.30, Concert from the Troyes Conservatoire.

by itself and coming to rest at the right spot. This particular set has AFC, and so long as the stations selected are normally strongly received and not subject to interference from their neighbours its operation is perfectly satisfactory. It's remarkably quick, too, the time taken to pass from Radio Normandie near the bottom of the medium-wave band to Athlone near the top being only a matter of a second or two. Another distinct advantage about this method of changing automatically from one station to another is that as soon as a button is touched the set is silenced until the desired station is reached. There are thus none of those highly unpleasant noises that may occur when the change is made manually, unless one remembers (as usually one doesn't) to turn the volume control right back during the process.

Future Refinements

Though the system described is undoubtedly good, and the set which incorporates it excellent value for money, we shall, I expect, see a good many refinements introduced when large and expensive auto-tuned receivers make their appearance. And the opportunity for refinements is almost unlimited. Here's one that I should like to see. As things are, touching the button of a station does not switch on the set if it was switched off beforehand. It would be an additional pleasure to be able to walk up to a silent receiver, touch one button and hear the selected station come in as soon as the valves had warmed up. Then, would not a button marked "Search" be rather jolly? My idea is that this should operate on all wavelengths. When the button was pressed and held down the set would not be silenced and AFC would be cut out. The pointer would travel very slowly over the scale, stopping as soon as one released the pressure on the button. This one would do when a desirable transmission had been found; AFC would then come into play to pull the set into perfect resonance. It seems quite possible, again, that we may have sets intended for reception of the highest possible quality of the local stations, and perhaps just one or two others, without any dials at all. Besides a small array of buttons the only controls needed would be for volume and for bass and treble accentuation. But these, once adjusted to the owner's liking, would seldom need to be touched again, and they could quite well be hidden away behind a small door in the cabinet. The auto-tuned set seems to have great possibilities, and I expect that enterprising manufacturers will not be slow to make the most of them.

A Good Way With Pirates

HOW many folk there are nowadays who diddle the G.P.O, the B.B.C. and their fellow listeners by using unlicensed receiving sets, no one knows. The figure is often put at about half a million, though I doubt whether it is quite so high as that. Still, the fact that successful prosecutions for the use of unlicensed sets are always being undertaken shows that there must be a good few pirates about. Long ago I suggested that no one should be able to purchase a radio receiver, or the parts from which to make one, without producing his receiving licence. There shouldn't be any great difficulty about enforcing such a regulation. After all, you have to show your fire-arms certificate if you want to buy a rifle, revolver or bulleted ammunition, and that system has been found quite satisfactory. I am glad to see that in Canada a scheme of this kind has been adopted by the Government. In that country, though, the licensing regulations are not quite the same as ours: a Canadian must have a licence for each and every receiver, though with us one licence covers as many non-portable receivers as we like (provided that they all belong to the licensee or to members of his household and are used under his roof), and one portable set as well. Even so, I can't see that any great difficulty would arise if the licence had to be shown before wireless goods could be bought.

On the Short Waves

Notes from a Listener's Log

AS most readers are probably aware, the Easter week-end was a very active one from the solar point of view.

With the appearance of two large sunspot groups it became obvious that considerable changes might occur, and this certainly proved to be the case. Two days after the meridian passage of the largest of the two groups the most severe magnetic storm in living memory was recorded. It stated at 05.48 G.M.T. and lasted until 16.30 G.M.T. on April 16th, the horizontal component of the earth's magnetic field being most affected, the variations at times amounting to almost one-eighth of the total force.

Prior to the magnetic storm, however, it had been noted by Greenwich that the leading group was very active spectroscopically and bright hydrogen eruptions were noted as follows:—

	Magnitude
April 12th 11.02—11.40 G.M.T. ..	2
April 12th 14.50—15.07 G.M.T. ..	2 minus
April 12th 15.03—15.10 G.M.T. ..	2
April 13th 09.45—11.52 G.M.T. ..	3 max. at 09.49
April 13th 10.54—11.30 G.M.T. ..	2
April 14th 10.12—10.39 G.M.T. ..	2

Magnitude 3 means that the eruption was a very extensive one, and most likely to produce the so-called Dellinger fade-out on the illuminated half of the earth.

It would be very interesting to hear if readers observed such fade-outs at the times and dates given above.

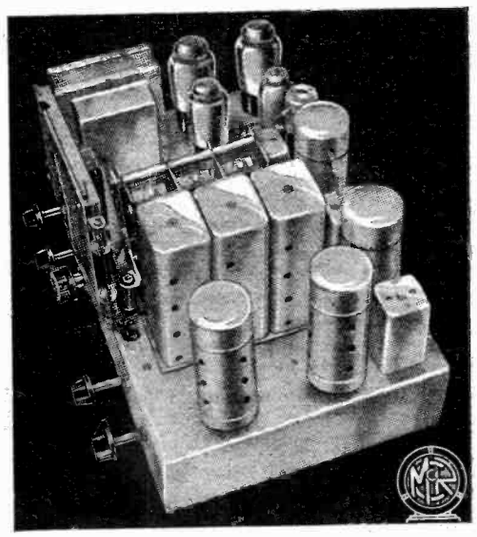
On the basis of this activity, and on statistical evidence which shows that spots having areas over 1,500 millionths of the sun's hemisphere are liable to produce magnetic storms on the second day after their meridian passage, the Royal Observatory warned the G.P.O. that disturbances with the telephone and telegraph circuits might be experienced. A prediction which very quickly proved to be correct.

From the short-wave point of view the dislocation of the North-American and Canadian services occurred even earlier than the magnetic storm proper. This is, of course, quite natural since a magnetic storm is almost certainly an earthly manifestation of very disturbed conditions in the ionised layers. Actually, both W3XAL and W2XAD became inaudible at about 16.00 G.M.T. on Friday, April 15th, the magnetic storm, as stated above, starting early on Saturday morning.

In spite of the disappearance of W3XAL

McCARTHY

The Chassis Specialists



IN modern radio practice, nothing is final; no receiver is so good that it is incapable of development in some detail.

Constant attention to improvement in small matters keeps McCarthy chassis in the forefront of modern chassis design and construction.

The receiver illustrated is the well-known McCarthy

9-VALVE 4-WAVE SUPERHETERODYNE

priced at 14 guineas including valves

The Circuit in Brief.—The pre-selector circuit is coupled to high-gain radio frequency amplifier operating on all 4 wave-bands, which is transformer-coupled to latest type triode-hexode frequency-changer. There are 2 band-pass transformer-coupled I.F. amplifiers (intermediate frequency 465 K.C.'s). The double diode second detector provides automatic volume control applied to 4 preceding valves, and first stage L.F. amplification. The triode phase-changer is capacity-coupled to push-pull output pentodes (or Harries-tetrodes) delivering 9 watts.

Principal Features.—Waveband coverage—12.8-33, 29-80, 190-550, 800-2,000 metres. Controls—sensitivity control (varying bias on R/F stage): 5-position wave-change and gramophone switch: combined volume control and on/off switch and progressive variable tone control (both operative on radio and gramophone).

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On the Short Waves—

and W2XAD, however, some 28 Mc/s signals from W4's made their appearance later and on Saturday, W4EPX in particular being in evidence.

Whether this is due to some peculiar virtue of 28 Mc/s under these conditions or to the very southerly location of Florida is not known.

A friend writing from Bogota, Colombia, tells me that on the night of the auroral display in January (January 25th) he noticed nothing abnormal in the performance of Daventry's short-wave service, even although this and other stations on all frequencies were completely inaudible in Canada and the U.S. on that occasion.

By the late afternoon of Easter Monday conditions seemed to have been restored to normal, and W2XE on 21.52 Mc/s was excellent around 4 and 5 p.m.

For those readers who are interested in picking up India here is the latest schedule of the A.I.R. short-wave stations: —

	B.S.T.
VUD2 Delhi 10 kW.	
9.59 Mc/s.	2.30—4.30 a.m. 7.30—9.30 „
4.995 Mc/s.	1.30—6.30 p.m.
VUB2 Bombay 10 kW.	
9.55 Mc/s.	7.00—9.30 a.m.
3.305 M/cs./	1.00—6.30 p.m.

Almost certainly the strongest reception will be from VUD2 on 9.59 Mc/s between 2.30 and 4.30 a.m., apart from the possibility of interference from W3XAU at this time, and PCJ if working.

Ultra-short Wave Portables

For the past week or so I have had the use of a Peto-Scott 5-10 metre portable, a review of which recently appeared in this journal.

This little portable, which you can buy practically over the counter, gives a very good account of itself on the Alexandra Palace sound at Epsom, in the valley, using only 5ft. of wire as an aerial with the receiver on the ground. The signals are definitely of the "phones on the table" variety and would comfortably work a small loud speaker. Excellent CW reception of crystal controlled 56 Mc/s signals was obtained, hand capacity being negligible. The new X23 battery triode-hexode is used as the mixer, followed by an IF stage on 2 Mc/s approx., with reacting detector and output tetrode, the total current consumption being about 9 mA. One should add, too, that the above results were obtained when the 120 volt HT battery was only showing 90 volts on load!

It is a good thing that moderately priced British receivers of this type are becoming available for amateurs in this country, especially at a time when competition between ourselves and our American cousins is getting very keen.

The latest development here is, perhaps, the production finally by R.C.A. of a steep-slope RF pentode, the 1,581, for television receivers, it now being admitted openly that the normal types, the 6C6, 6D6 and their octal equivalents, the 6J7 and 6K7, are entirely unsuitable for ultra-short wave work.

What is more, the R.C.A. television transmitter on top of the Empire State building is now to be modified to bring it more in line with current B.B.C. practice at Alexandra Palace. In future, one understands, the DC component will be radiated, as has been the case with our own television transmitter since its inception.

ETHACOMBER.

Valve Nomenclatur

By R. M. V. WESTON

THE present system of designating valves is one which leaves much to be desired, for the type numbers often convey little or no useful information. They serve merely as distinguishing marks and do not indicate the electrical characteristics.

Any attempt to convey precise information on the useful characteristics of a valve in its type number is unfortunately foredoomed to failure, for it leads to an appallingly complicated array of letters and numbers. The matter is much simpler, however, if the attempt is made

SUGGESTED METHOD OF VALVE NOMENCLATURE

Electrodes.	Type.	Symbol.	Meaning.	Example.
DIODES	HT power rectifiers	R	Rectifier	
	Do. do. for 250 v. ... add	2		R2
	Do. do. 350 v. ... „	3		R3
	Do. do. 500 v. ... „	5		R5
	RF rectifiers for detection, AVC, etc. ...	D	Diode	
	Gas-filled HT power rectifiers	G	Gaseous	
DOUBLE DIODES	Any of above types ... ... prefix	2		2R3, 2D, etc.
TRIODES	Output triodes	T	Triode	
	[Also general symbol for the word triode when used with an additional word as in Triode-Hexode, Double diode-triode, etc.]			TX, 2DT
	High resistance triodes (over 7,000 Ω) add	H	High	TH
	Gas-filled triodes or relays ... add	R	Relay	TR
	Double triodes for "Class B" operation	B	Class B	
TETRODES ...	Screen grid tetrodes	S	Screen	
	Do. do. with variable mutual conductance add	V	Variable	SV
	Output or "kinkless" tetrodes	K	Kinkless	
PENTODES ...	Output pentodes	P	Pentode	
	[Also general symbol for the word pentode when used with an additional word as in Triode-pentode, etc.] ...			TP
	High frequency pentodes ... add	H	HF	PH
	Do., with variable mutual conductance ... ... add	V	Variable	PV
	Double pentodes for "Quiescent" operation	Q	Quiescent	
HEXODES ...	... ...	X	Hexode	
HEPTODES ...	... ...	H	Heptode	
OCTODES ...	... ...	O	Octode	
	Triode-Pentode			TP
	Triode-Hexode			TX
CATHODES and HEATERS.	If cathode is filamentary	F	Filament	
	Filament voltage	2, 6, etc.		F2, F6
	With I.H.C., heater *not* 4 v. 1 A. or 4 v. 2 A., heater voltage	4, 200, etc.		
	Do. 4 v. 1 A.	41		
	Do. 4 v. 2 A.	42		
	Do. 6.3 v., current *not* 0.2, 0.3, 0.4 or 0.6 A.	A	Automobile	(American)
	Do. 6.3 v. 0.2 A.	A2	Do. 0.2 A.	
	Do. 6.3 v. 0.3 A.	A3	Do. 0.3 A.	
	Do. 6.3 v. 0.4 A.	A4	Do. 0.4 A.	
	Do. 6.3 v. 0.6 A.	A6	Do. 0.6 A.	
	Do. 13 v. 0.2 A.	C2	Car 0.2 A.	(English)
	Do. 13 v. 0.3 A.	C3	Do. 0.3 A.	
	Do. 13 v. 0.4 A.	C4	Do. 0.4 A.	
	Do. 13 v. 0.6 A.	C6	Do. 0.6 A.	
	Do. Universal AC/DC, current *not* 0.2, 0.3, 0.4 or 0.6 A.	U	Universal	
	Do. do. 0.2 A.	U2	Do. 0.2 A.	
	Do. do. 0.3 A.	U3	Do. 0.3 A.	
	Do. do. 0.4 A.	U4	Do. 0.4 A.	
	Do. do. 0.6 A.	U6	Do. 0.6 A.	

Note.—Should two or more types of valve (made by the same manufacturer) have the same symbol under this system and be dissimilar in some respects, distinguishing symbols should be added to indicate such differences. The differentiating symbols may be the letters A, B, C, etc., as now occasionally used and would have no strict meaning. They would only indicate dissimilarity between types.

A	Mazda TPF2A
B	TPF2B
C, etc.	Mullard 2D4A
	2D4B

New Scheme for Simplifying Identification

to indicate only the general type of a valve together with its filament or heater voltage and current.

A new scheme of this nature has been worked out and is given here together with a number of examples. It may be said that if this suggestion were adopted indiscriminately it would lead to confusion since different valves by different makers might bear the same type number. This is, however, a state of affairs by no means unknown to-day, so that conditions could be no worse.

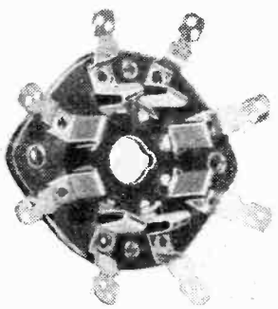
To obtain the full value of this scheme it would have to be generally adopted by valve makers, and if close co-operation between them could be achieved it might be possible to obtain that desirable condition where a valve type XYZ is the same no matter by whom it is made.

EXAMPLES.

Valve.	Maker.	Present Type No.	Suggested Symbol.	Interpretation.
FREQUENCY-CHANGERS	Cossor ...	41MPG	H41	Heptode I.H.C. 4 v. 1 A.
	Osram ...	X22	HF2	Heptode filament, 2 v.
	Mazda ...	TP23	TPF2	Triode-pentode filament, 2 v.
	Mazda ...	ACTH1	TX4	Triode-hexode I.H.C. 4 v. not 1 A. or 2 A.
	Mullard ...	FC13c	OC2	Octode I.H.C. Car-type 13 v. 0.2 A.
SCREEN-GRID TETRODES	Osram ...	MS4	S41	Screen-grid tetrode, I.H.C., 4 v. 1 A.
	Mullard ...	PM12	SF2	Screen-grid tetrode, filament, 2 v.
	American	36	SA3	Screen-grid tetrode, Auto-type, 6.3 v. 0.3 A.
H.F. PENTODES ...	Mullard ...	SP13C	PHC2	Pentode, H.F., I.H.C., Car-type, 13 v. 0.2 A.
	American	6J7	PHA3	Pentode, H.F., I.H.C., Auto-type, 6.3 v. 0.3 A.
	American	6B7	2DPVA3	Double-diode, H.F. variable-mu, I.H.C., Auto-type, 6.3 v. 0.3 A.
DIODES	Cossor ...	DD4	2D4	Double-diode, R.F., I.H.C., 4 v (not 1.0 A. or 2.0 A.).
TRIODES	Osram ...	MH41	TH41	Triode, Ra>7,000Ω, I.H.C., 4 v. 1 A.
	Mullard ...	MZ05-60	TF6	Triode, Ra<7,000Ω, filament, 6 v.
	American	76	THA3	Triode, Ra>7,000Ω, I.H.C., Auto-type, 6.3 v. 0.3 A.
OUTPUT TETRODES and PENTODES	Brimar ...	7D6	PU2	Output pentode, I.H.C., Universal, 0.2 A.
	Osram ...	KT42	K42	Output tetrode, I.H.C., 4 v. 2 A.
	American	38	PA3	Output pentode, I.H.C., Auto-type, 6.3 v 0.3 A.
DOUBLE OUTPUT VALVES	Osram ...	B21	BF2	Class B double-triode, filament, 2 v.
	Osram ...	QP21	QF2	Double-pentode, filament, 2 v.
RECTIFIERS ...	Brimar ...	1D5	R2U2	H.T. Rectifier: 250 v., Universal, I.H.C., 0.2 A.
	American	80	2R4F5	Double H.T. rectifier, 400 v. filament, 5 v.

CLIX VALVE HOLDER

A NEW valve holder for American Octal-base valves has been produced by British Mechanical Productions, Ltd., of 79a, Rochester Row, London, S.W.1. The holder is of the chassis-mounting type and



For valves with the American Octal-base.

the spring contacts are floating, making for easy insertion of the valve and giving an anti-microphonic action. There is a line pressure between the contacts and the valve pins, and they are self-cleaning. Unusually low losses are also claimed, as the metal parts only contact with the solid dielectric at the rivets, which are widely separated.

This new product is at present available to manufacturers only.

This firm is also producing an Octal-valve top-cap connector. It consists of a split ring fitted with a terminal of black insulating material. It is priced at 1½d.

The well-known Clix All-In Terminal is now available in brown, with markings for Aerial, Earth, Input or Output. It is listed at 6d.

E.T.L. VALVE TESTER

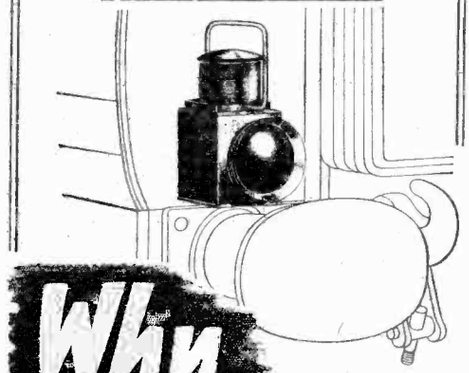
IN the review of the Electrical Test Laboratories' Valve Tester which appeared in *The Wireless World* for April 14th, 1938, it was not perhaps made sufficiently clear that this equipment enables valves of all types to be checked. Not only can all standard types of British, American and Continental valves be tested, but also the Ostar-Ganz types.

The meter included is also available for external use as a three-range voltmeter.

L'Encyclopédie de la Radioélectricité, A-G.—Etienne Chiron, 40, Rue de Seine, Paris-VIe.

The first volume of an encyclopedia covering electrical and wireless matters has been received. It is in French, but at the end of the explanatory paragraphs the English and German equivalents of the word or phrase are given.

T.C.C.
1906 CONDENSER SPECIALISTS FOR OVER THIRTY YEARS 1938



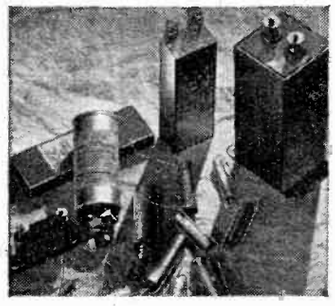
Why a tail-lamp in daylight?

Why do *all* trains—goods and passenger—carry a tail lamp—even in daylight? For safety—for signalmen to check that the train is complete—that no vehicles have broken away.

Wise set-makers and discreet amateurs fit T.C.C. Condensers for the same reason—for safety. Because they know that backing each condenser is 32 years of specialised research—32 years devoted to building condensers and nothing but condensers. Because they know they're *safe* with T.C.C.

. . for the same reason that wise setmakers and shrewd amateurs always use

T.C.C.
ALL-BRITISH
CONDENSERS



THE TELEGRAPH CONDENSER CO. LTD.
WALES FARM RD. NORTH ACTON, W.3

CA 656

Recent Inventions

Brief descriptions of the more interesting radio devices and improvements issued as patents will be included in this section

"DIELECTRIC GUIDES"

IN order to amplify or relay very high-frequency currents along a transmission line of the so-called "dielectric-guide" type, a special triode valve is used having a control grid in the form of a perforated wall or "septum," which divides the valve into two separate chambers. The transmission line is broken at the relay point, and its two ends are made to overlap along the grid or "septum" of the valve, which is thus made common to both parts of the line.

This prevents undesirable capacity coupling between the valve electrodes, and confines the energy transfer to the electrons passing through the meshwork of the grid. The two overlapping parts of the guide-line may also be provided with "iris" diaphragms, which are spaced a quarter wavelength away from the coupling-grid, so as to form end-sections tuned to the working wavelength.

Standard Telephones and Cables, Ltd. (communicated by Western Electric Inc.). Application date, March 1st, 1937. No. 478462.

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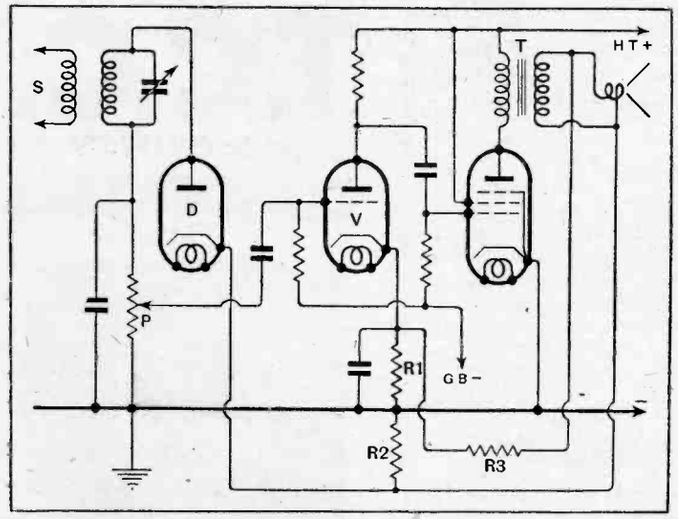
NEGATIVE FEED-BACK

THE figure shows a low-frequency amplifier in which a negative feed-back circuit comprising resistances R1, R2, R3 is branched across the secondary of the output transformer T. High-frequency signals may be applied at S, rectified at D, and applied through a potentiometer P to the amplifier V. Or the pick-up from a gramophone may be applied directly across P. One advantage of the arrangement is that any distortion components present will be reduced by the negative feed-back from R1 on to the grid of the amplifier V. Then if a non-linear resistance, such as a tungsten-filament lamp filament, is used, say, as the resistance R3, its resistance will increase with the output voltage, and this in turn, will decrease the negative feed-back across R1. In other words, the overall gain of the amplifier will increase with signal strength, thus giving the effect of volume expansion.

If, on the other hand, the resistance R1 is replaced by the tungsten-filament, the amount of negative feed-back will increase with the output voltage, and this will give the effect of volume contraction. Alternatively, a non-linear resistance having a negative temperature coefficient, such as a carbon filament, can be used to give similar but opposite effects.

G. W. Johnson (communicated by Philco Radio and Television Corporation). Application date, August 4th, 1936. No. 479485.



Negative feed-back amplifier, which may also include volume expansion or contraction.

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CATHODE-RAY TUBES

IN focusing the electron stream of a cathode-ray tube on to the fluorescent screen, it is possible to use either the magnetic field from a winding located outside the glass tube, or the electric field from electrodes carrying high voltages inside the tube. The latter arrangement is generally preferred, because there are certain disadvantages attaching to the use of external windings.

According to the invention, the electron stream is focused by a combination of electric and magnetic fields, both of which are produced inside the tube. The focusing electrodes are cylindrical in form, and are made of some permanently magnetised metal, say steel or a "Heusler alloy." Preferably two such electrodes are arranged immediately after the anode, the adjacent ends being of opposite polarity. They are also biased with an increasing positive voltage to provide an electrostatic focusing component.

Zeiss Ikon Akt. Convention date (Germany) May 28th, 1936. No. 478410.

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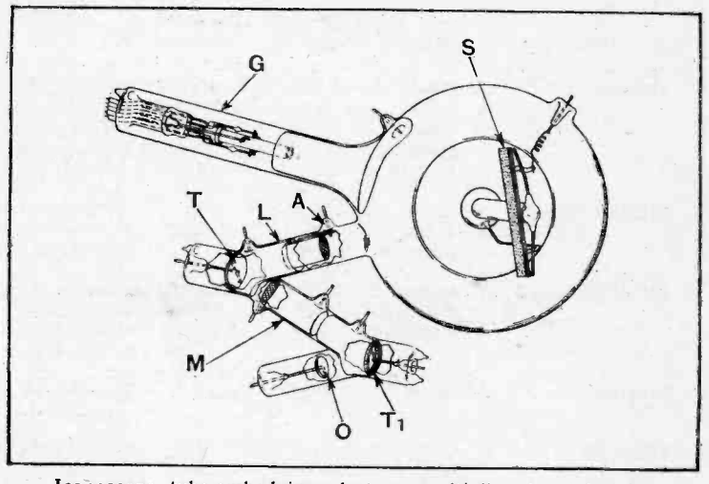
TELEVISION TRANSMITTERS

THE figure shows a television transmitter of the Iconoscope type in which means are provided to intensify signal currents by secondary emission. The picture to be televised is first projected on to a photo-sensitive screen S of the mosaic-cell type (shown foreshortened) which is then scanned by the electron stream from the gun G of the tube. Instead of using the resulting discharges from the back of the screen for signalling in the normal way, advantage is taken of the fact that as the electron stream passes over the screen S secondary electrons are emitted in proportion to the light intensity of each picture point.

These are attracted into the "leg" L of an electron-multiplier M by the high biasing-voltage on an accelerating electrode A, and are made to impact first against one target electrode T and then against a second electrode T1. Secondary emission takes place at each impact, so that a greatly amplified signal current becomes available at the output electrode O.

Marconi's Wireless Telegraph Co., Ltd. Convention date (U.S.A.), July 26th, 1935. No. 478967.



Iconoscope tube embodying electron multiplier for television transmission.

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WHEN televising, say, from a studio, where the scene is artificially illuminated, the reflected light supplied through the scanning device to the photo-electric cell may contain, in addition to the ordinary light-and-shade effects, a fluctuating component from the flood-light lamp, particularly if the latter is energised from alternating mains.

In order to remove this undesirable component from the signal currents, a second photo-electric cell is arranged to receive light direct from the lamp, the resulting currents from that cell being supplied to amplifiers, arranged in parallel with the main signal amplifiers, and including a phase-changing circuit and a telephone. The telephone is coupled to a microphone in the output circuit of the main amplifier. The result is that the "undesirable" current fluctuations in the parallel circuit are fed back in phase-opposition with those in the main amplifier so that the two cancel out.

Standard Telephones and Cables, Ltd. (assignees of A. W. Horton, Junr.). Convention date (U.S.A.), July 23rd, 1936. No. 480483.

TELEVISING FROM AN AEROPLANE

IN war time the pilot of an aeroplane may require to transmit from his machine, whilst in flight, pictures of an enemy terrain, such as a gun emplacement or other position of military interest. If high-speed scanning is used, the movement of the machine will not make much difference to the transmitted picture, but practical considerations appear to rule out any but the simplest type of transmitting apparatus.

This naturally implies a low-speed of scanning in which case the rapid movement of the machine would lead to distortion.

The invention discloses means for producing, at the transmitter, an additional movement in the direction of line-scanning, and at the frequency of frame scanning, so as to compensate for the motion of the transmitter when in operation. The correction is derived from the time-base circuits, in the case of a cathode-ray tube, or by imparting an additional swing to a vibrating-mirror scanner.

Baird Television, Ltd., T. M. C. Lance; and B. B. Austin. Application date, August 6th, 1936. No. 479458.

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